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PREDICTING SUCCESS IN TENTH GRADE GEOMETRY

Submitted by

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CHAPTER I

INSTRUMENTS FOR PREDICTING SUCCESS IN GEOMETRY

Value of prognosis:-- In some high schools plane geometry is still a required tenth-grade subject for all pupils enrolled in the college course. Many of these pupils fail. Of the 113 pupils in this paper, 40 pupils, or 35.4 per cent, failed the first semester of tenth-grade plane geometry. Of the 73 pupils who passed, eight were repeating geometry. Disregarding these eight the percentage of failures increases to 38.1. If it can be determined in advance that certain pupils will very probably fail, these pupils can be spared a half year or full year of wasted time, a sense of failure, no increase in mental growth, and loss of credits needed for graduation. These same pupils in September can be guided toward subjects which their ability and interest will enable them to study profitably.

Such determination in advance can also prove of advantage to pupils who show probability of passing but whose subsequent work is failing. Further investigation may trace such failure to physical defects, reading difficulty, poor study methods, or poor teaching methods.

[illegible]

[illegible]

[illegible]

[illegible]

Pupils enrolled in courses other than the college course have no opportunity to study mathematics other than commercial arithmetic. Just recently college-course pupils have been allowed to invade the commercial field especially to study typewriting and stenography. It may be that there are pupils in the commercial course who are not achieving their maximum mental growth because they are deprived of an opportunity to study subjects restricted to college-course pupils. If a method can be devised to foretell probable success or failure in geometry, interested pupils who show high probability of success may be allowed to take geometry in addition to the commercial subjects.

Studies in Predicting Success in Geometry

Previous records and pre-geometry tests as predictive instruments.-- In Kelley,[1/] Educational Guidance, the following sources for predicting success in English, mathematics, and history were used: the grammar-school record; age; previous teachers' estimates of intellectual ability, conscientiousness, emotional interest in the work, oral expression; and grades in tests given at the beginning of the year in mental capacity, preparation for the particular course, and effort and interest in the subject.

1/ Truman Lee Kelley, Educational Guidance - Teachers College Contributions to Education, No. 71. Teachers College, Columbia University, New York, 1914, vi + 116 p.

It was found that of these the grammar-school record is the most reliable and age is the least reliable. The grammar-school record, however, was correlated with ninth-grade marks only. The coefficient of correlation between previous teachers' estimates and mathematics achievement was .61; between all the initial tests and geometry achievement, .44; and between the interest tests and mathematics achievement, .30.

In Rogers,[1/] Experimental Tests of Mathematical Ability and Their Prognostic Value, 17 tests were administered to 114 girls - tests of algebraic abilities, skill in arithmetic problems, reasoning ability, geometric abilities, and language abilities. It was found that these tests foretell how well a pupil will do in geometry about three fourths as accurately as does his ninth-grade record in algebra. Again age was found not to be a reliable factor for prognosis in geometry.

In Lee and Lee,[2/] "Some Relationships Between Algebra and Geometry," it was found that the coefficient of correlation between scores on Lee Test of Algebraic Ability and

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1/ Agnes Low Rogers, Experimental Tests of Mathematical Ability and Their Prognostic Value - Teachers College Contributions to Education No. 89. Teachers College, Columbia University, New York, 1918, v + 118 p.

2/ Dorris May Lee, and J. Murray Lee, "Some Relationships Between Algebra and Geometry," Journal of Educational Psychology (October, 1931) 22: 551-560.

scores on Lee Test of Geometric Aptitude was .60 ± .04; between teachers' marks in algebra and teachers' marks in geometry, .474 ± .044; and between scores on an unstandardized algebraic achievement test and scores on the Renfrow Geometry Test, .410 ± .048. Lee and Lee also quoted from previous studies the following coefficients of correlation between teachers' marks in algebra and teachers' marks in geometry: Burris found it to be .57; Crathorne, .52 ± .02; and Winegardner, .509 ± .024.

In Cooke and Fields,[1] "The Relation of Arithmetical Ability to Achievement in Algebra and Geometry," it was found that arithmetical ability does not correlate highly with achievement in geometry.

In Cooke and Pearson,[2] "Predicting Achievement in Plane Geometry," it was found that the Orleans Geometry Prognosis Test is not appreciably more accurate in predicting than the Terman Group Test of Mental Ability, or than the teachers' algebra marks. The coefficient of correlation between teachers' algebra marks and teachers' geometry marks was .388 for Group 1 and .546 for Group 2.

1/ Dennis H. Cooke, and Carl L. Fields, "The Relation of Arithmetical Ability to Achievement in Algebra and Geometry," Peabody Journal of Education (May, 1932) 9: 355-361.

2/ Dennis H. Cooke, and John M. Pearson, "Predicting Achievement in Plane Geometry," School Science and Mathematics (November, 1933) 33: 872-878.

The coefficient of multiple correlation between a combination of the three predictive instruments and teachers' geometry marks was .436 for Group 1 and .625 for Group 2. The coefficient of multiple correlation between a combination of the three predictive instruments and scores in the Columbia Research Bureau Plane Geometry Test Form A was .747.

In Orleans,1/ "A Study of Prognosis of Probable Success in Algebra and in Geometry," the writer outlined the method used to construct a test to measure specific aptitude for geometry. The coefficient of correlation between the prognostic test scores and geometry marks was higher than between I.Q.s and geometry marks. The coefficient of multiple correlation between a combination of prognostic test scores and I.Q.s and geometry marks was slightly higher. Orleans also quoted from previous studies the following coefficients of correlation between I.Q.s and teachers' marks in geometry: Brooks found it to be .51; Todd, .33.

In Lee and Hughes,2/ "Predicting Success in Algebra and Geometry," the correlation of a combination of the

1/ Joseph B. Orleans, "A Study of Prognosis of Probable Success in Algebra and in Geometry," <u>The Mathematics Teacher</u> (April and May, 1934) 27: 165-180, 225-246.

2/ J. Murray Lee, and W. Hardin Hughes, "Predicting Success in Algebra and Geometry," <u>The School Review</u> (March, 1934) 42: 188-196.

scores on the Hughes Trait Rating Scale and I.Q.s with teachers' geometry marks yielded a coefficient of .57; a combination of scores on the Lee Test of Geometric Aptitude and I.Q.s with teachers' geometry marks yielded a coefficient of .66; and a combination of scores on Trait Rating Scale and Geometric Aptitude Test with teachers' geometry marks yielded a coefficient of .67. The coefficients of correlation between a single one of these predictive instruments and teachers' geometry marks were all appreciably lower than .57.

In Richardson,[1] "Predicting Achievement in Plane Geometry," grades in each of eight instruments of predicting success in geometry were correlated with teachers' marks in geometry for 135 pupils:

second semester algebra marks	.702 ± .030
teachers' estimates of ability to do geometry	.672 ± .032
Orleans Geometry Prognostic Test	.669 ± .032
Research Office Prognostic Test	.637 ± .034
first semester algebra marks	.625 ± .035
Iowa Algebra Prognostic Test	.504 ± .043
Terman I.Q.	.501 ± .043
teachers' ratings on studiousness	.338 ± .052

In Hummer,[2] "A Comparison of I.Q. and Achievement in Plane Geometry," the coefficient of correlation between scores on the Otis Group Intelligence Scale, Advanced

1/ H. D. Richardson, "Predicting Achievement in Plane Geometry," The Mathematics Teacher (May, 1935) 28: 310-319.

2/ Vivian L. Hummer, "A Comparison of I.Q. and Achievement in Plane Geometry," School Science and Mathematics (May, 1936) 36: 496-501.

Examination, Form A, and scores on the Columbia Research Bureau Plane Geometry Test (minus the sixth part geometry score) was .53 ± .039. The conclusion reached in this study was that failure in geometry is likely to occur if the I.Q. is below a range level between 100 and 110.

In Hamilton,1/ "A Method for Reducing Failures in Plane Geometry," a point-average of ninth-grade algebra and English marks (mark A equivalent to 4.00 points) was compared with first-semester geometry mark in 1934 and 1935. The pupils beginning geometry in 1935 were advised of the 1934 conclusions. After both years the decision was: the pupils with point-average over 2.00 are capable of passing geometry, pupils with point-average of 2.00 have an even chance of passing or failing, pupils with point-average below 2.00 will not pass geometry. Two facts of interest might be noted. Although in 1934 of 13 pupils with point-average of 2.00, six failed;in 1935 of 12 pupils with point-average of 2.00, none failed. Perhaps the awareness of their danger contributed to their improvement. Hamilton states that during the depression years he was primarily interested in a predictive instrument that would not increase the tax-payers' burden.

1/ J. Landon Hamilton, "A Method for Reducing Failures in Plane Geometry," Journal of Educational Research (May, 1937) 30: 700-702.

Previous records and intelligence quotients useful for prognosis.-- Table 1 indicates which instruments the ten studies here summarized have found to be of definite value in predicting probable success in geometry.

Table 1. Number of Studies Advocating Each Predictive Instrument

Predictive Instrument	Number of Studies
Ninth-Grade Algebra Mark...	4
Intelligence Test..........	3
Ninth-Grade English Mark...	1
Grammar-School Record......	1

Two found age of no predictive value and one found arithmetic mark of no predictive value.

Predictive Instruments Used in This Paper

Algebra marks and intelligence quotients correlated with geometry marks.-- In this paper the ninth-grade algebra mark and the I.Q. have been correlated with the teachers' mark in first-semester geometry and with the test mark in first-semester geometry to determine their value in predicting probable success in tenth-grade geometry.

The test used to measure achievement at the end of the first semester covered the material in Book I. As no

commercial test was available which covered the required material in a time limit which coincided with the length of the school periods, the teacher constructed a test,[1] endeavoring to make it as objective as possible. The test has two parts, given on consecutive days. The coefficient of correlation between the scores on part I and scores on part II is .72 $\pm$ .03.[2]

The test marks and the teacher's semester marks for 85 pupils, distributed as in Table 2, have been correlated. Sixteen pupils were transferred to another teacher and twelve were absent on the days of the test; these 28 took different achievement tests.

The coefficient of correlation between the test marks and the teacher's marks is .78 $\pm$ .03.[3] This is far from perfect correlation but it is not unusual to find a difference between the two measures of achievement. Neither the test mark nor the teacher's mark is a perfect measure. The test may not be a fair test of the material taught, or it may test on material imperfectly taught and therefore inadequately learned. The teacher's marks are occasionally colored by proximity to line between passing and failing, pupil's effort, pupil's health, pupil's unusual home conditions.

1/ See appendix, pp. 39-41.

2/ Ibid, p. 44.

3/ Ibid, p. 45.

Which is the better measure of achievement is a debatable question. In the school in which this study was made, the custom is to consider the achievement-test mark as one fourth of the teachers' mark for the semester.

Abilities required to pass geometry.-- Another method

Table 2. Distribution of Achievement-Test Scores and Teacher's Geometry Marks for 85 Pupils

Teacher's Marks	Term Test										
	0 9	10 19	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10	11	12
91-97...									1	1	2
84-90...								2	4	1	7
77-83...				1		1		1	3	2	8
70-76...					1		1	4	3	1	10
63-69...	1		1	2	2	9	4	2			21
56-62...			1	1	6	5	1				14
49-55...		2	4	2	2	1					11
42-48...	1		3			1					5
35-41...			1	3							4
28-34...				1							1
21-27...		1	1								2
Total...	2	3	11	10	11	17	6	9	11	5	85

for predicting success in geometry is to analyze the content of the course to determine if possible the specific abilities needed in addition to general intelligence to pass geometry. In an intelligence test the specific abilities are obscured in the final I.Q. Tests on these

abilities have been formulated to be given to pupils before they begin to study geometry. The mark on such a prognostic test is considered an indication of the pupil's preparedness for geometry and probable success.

Algebra with particular stress on ratio and proportion, arithmetic, and English with stress on reading with comprehension have been considered necessary preparation for studying geometry.

Some teachers feel that unless a pupil has already developed slight reasoning ability, the possibility of his success in geometry is small. In the opinion of these teachers pupils should be able to:

apply a general principle to a particular problem
analyze data to find the general principle applicable to the situation
select relevant features in problem solving
see likenesses and differences
arrange facts in proper order
understand the principle of converses
deduce if this is true, then that is true.

All of these reasoning abilities are used in the mastery of geometric theorems and originals.

The ability to visualize and understand spatial relationships may be indicative of a pupil's future success in geometry. Tests may be administered to determine the pupil's ability to:

hold a geometric figure in mind
understand references to a geometric figure
study a geometric figure
infer from spatial data

image geometric movements
understand the principle of symmetry.

Another method used in prognostic tests is to present some geometric facts and require the pupils to assimilate and use them immediately to do elementary problems in geometry. Their method of doing such tasks as these:

apply the axioms to geometry
master geometric vocabulary
decide and express geometrically the "given" and "to prove"
solve problems demanding common sense interpretation of geometric facts

may indicate their method of doing future geometric problems.

Table 3 shows the number from 15 studies that found the following specific abilities necessary for probable success in geometry.

Table 3. Number of Studies Considering Each Ability Necessary for Success in Geometry

Specific Ability	Number from 15 Studies
General intelligence..........	9
Algebra...	8
Reasoning ability.............	8
Image and understand spatial relationships................	6
Perform geometric tasks........	4
Arithmetic....................	4
Read with comprehension.......	3
English.......................	2
Understanding of ratio and proportion..................	1

After a survey of geometric prognosis tests and a more detailed study of the Lee Test of Geometric Aptitude, the Iowa Plane Geometry Aptitude Test, and the Orleans Geometry Prognosis Test, the Lee Test of Geometric Aptitude-Form A [1/] has been used in this study as a prognostic instrument. The Lee Test covers the specific abilities previously listed. Its reliability is .911 $\pm$ .011. In checking its validity the authors found the coefficient of correlation between the aptitude test and achievement test to be .72 $\pm$ .028 in 135 cases in one school; in five schools the correlation ranged from .477 to .637. In addition the length of the school period of the pupils in this study provided sufficient time for the Lee Test.

The Revised Minnesota Paper Form Board Test-Series AA [2/] has also been used and the results correlated with geometric achievement. The Minnesota Test is a test of mechanical ability but it is considered in this paper because it uses geometric figures, geometric movement, symmetry, and requires the ability to visualize and study a geometric figure.

In this study the ninth-grade algebra mark, I.Q., score on Lee Test, and score on Minnesota Test have been correlated with geometry achievement in the first semester

1/See appendix, p. 42.

2/Ibid, p. 43.

as measured by teachers' marks and by an achievement test.

CHAPTER II

CORRELATION BETWEEN PREDICTIVE SCORES AND ACHIEVEMENT SCORES

Lee Test of Geometric Aptitude

On the third day of school in September, 1944, the Lee Test of Geometric Aptitude-Form A was administered to ninety pupils in three different classes of tenth-grade geometry. The first day was devoted to registration and the second day to a review of algebra with no reference to geometric figures or formulas. Of the ninety pupils only six had previously studied geometry and failed. The scores on the Lee Test of these six pupils who were repeating geometry ranged from 0 to 57 out of a possible score of 80. This range is wide enough and the number of scores is small enough not to influence the total scores in any direction. Therefore the six repeaters are included in the total ninety without further consideration. The remaining 84 pupils had no training in either intuitive or demonstrative geometry.

The scores on the Lee Test, Table 4, are lower than the norms for the test published in the test manual. This is partly due to the honor class system. Approximately

the 50 top-ranking pupils in ninth-grade algebra are placed in two honor divisions in tenth-grade geometry. These two groups cover more subject matter and do more originals than the regular geometry classes. The three classes used in this study are regular geometry classes. There is no need of an instrument to predict success or

Table 4. Distribution of Lee-Test Scores for 90 Pupils

Scores on Lee Test	Number of Pupils
60-69..........	5
50-59..........	4
40-49..........	11
30-39..........	20
20-29..........	26
10-19..........	16
0- 9..........	8
Total..........	90

failure in geometry for the honor divisions. The very few pupils who do have difficulty are given individual help until the difficulty is cleared up. If it is discovered that they cannot keep up with the honor divisions, they are transferred to the regular classes where the slower method presents no difficulties for them.

Of the ninety pupils who took the Lee Test, two pupils transferred to a different school before the semester ended and their geometry marks were not available.

Of the remaining 88 pupils, 13 were transferred to a different geometry teacher in the same school and their marks are included.

Teachers' geometry marks and Lee-Test scores.-- For these 88 pupils the scores on the Lee Test have been correlated with the teachers' first-semester geometry marks. The Lee Test scores in no way affected the teachers' marks as the tests were set aside in September and not scored until after the first-semester marks were recorded. The coefficient of correlation between the teachers' marks and the Lee-Test scores, listed in Table 5, is $.63 \pm .04$.[1]

This value of r, $.63 \pm .04$, denotes that there is a significant fairly substantial relationship between the Lee-Test scores obtained in September and the teachers' geometry marks of the following January. Therefore the Lee Test can be used as an instrument for predicting success in geometry. A pupil's probable mark in geometry can be estimated from his Lee-Test score by means of the regression equation between the Lee-Test scores and geometry marks of previous classes.

It must be remembered, however, that this is an estimated, probable mark determined by using means of scores obtained from a sample group. An r of .63 has 22%

1/See appendix, p. 46.

efficiency in predicting.[1] Such a mark should be only a starting point in guiding a pupil to study or not to study geometry. The whole individual pupil must be considered.

Of the 18 pupils who obtained a score below 17 in the Lee Test, 14 failed geometry and 4 passed. One of the

Table 5. Distribution of Teachers' Geometry Marks and Lee-Test Scores for 88 Pupils

Scores on Lee Test	Teachers' First-Semester Geometry Marks									
	10 19	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10	11
60-69...						1	1	2	1	5
50-59...							2	2		4
40-49...					1	4	5	1		11
30-39...				2	4	6	4	3		19
20-29...		1	3	2	6	10	2	1		25
10-19...		2	1	2	5	6				16
0- 9...	1		3	1	2	1				8
Total...	1	3	7	7	18	28	14	9	1	88

four had transferred from Georgia and had taken the Lee Test on his third day in a school to which he had not yet become adjusted. A second boy of the four proved to be a consistently slow worker defeated by the timing in the Lee

1/Henry E. Garrett, Statistics in Psychology and Education. Longmans, Green and Co. New York, 1941, p. 346.

Test. A third boy, whose Lee-Test score was zero, was a repeater definitely provoked to be with the same teacher who had "failed" him the preceding year. He was transferred to another teacher. The fourth pupil was also transferred to another teacher before the reason for her taking geometry in the eleventh grade was discovered. It would have been most unwise to advise at least the first three of these pupils solely on the basis of the Lee-Test score.

As Test 2 in the Lee Aptitude Test is distinctly different from the other three tests - containing no geometry, the combined scores on Tests 1, 3, and 4 have been correlated with the teachers' semester marks; the coefficient of correlation is $.56 \pm .05$.1/ Between Test 2 scores and teachers' marks the coefficient of correlation is $.48 \pm .05$.2/ The entire Lee-Test score including arithmetic, algebra, and geometry is a better predictive instrument than its individual tests. This is perhaps because all three subjects are needed for tenth grade geometry.

Achievement-test scores and Lee-Test scores.-- Only 65 of these 88 pupils took the geometry achievement test given at the end of the first semester after Book I had been completed. The distribution of scores is shown in Table 6. The 13 pupils who had been transferred to a

1/ See appendix, p. 47.

2/ Ibid, p. 48.

different geometry teacher did not take the same test; ten other pupils were absent and took a make-up test later. The Lee-Test scores of these 65 pupils have been correlated with the scores on the achievement test. The coefficient of correlation is $.69 \pm .04$.[1] An r of .69 has 28 per cent efficiency in prediction.

Table 6. Distribution of Achievement-Test Scores and Lee-Test Scores for 65 pupils

Scores on Lee Test	Achievement-Test Scores										
	0 9	10 19	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10	11	12
60-69...							1	1	2	1	5
50-59...									3		3
40-49...						2		1	1	2	6
30-39...		1		2	3	3	1	4			14
20-29...		1	3	3	5	4		1	1		18
10-19...	1	1	5	3	2	3					15
0- 9...			2		1	1					4
Total...	1	3	10	8	11	13	2	7	7	3	65

The value of r, then, is slightly higher for the achievement test scores ($.69 \pm .04$) than for the teachers' marks ($.63 \pm .04$) in relation to the Lee-Test scores. This is very often the case. It has previously [2] been noted

1/See appendix, p. 49.

2/See p. 9.

that the correlation between test marks and teachers' marks is not perfect. Both the test scores are objective whereas the teachers' marks tend, perhaps unfortunately, to be subjective.

The difference between the two values of r is not unduly great. This is due to the fact that pupils usually do about the same level of work on the achievement test as they have done during the semester. Also the achievement-test score is included in the semester mark. Therefore the Lee Test can be used as an instrument of prediction of success in geometry whether measured by teachers' marks or by achievement-test scores.

Revised Minnesota Paper Form Board Test

Teacher's geometry marks and Minnesota-Test scores.-- At the beginning of the second week of school, after classes had been readjusted for size, the Revised Minnesota Paper Form Board Test-Series AA was administered to 80 pupils in the same three geometry classes. Of the six pupils who were repeating geometry and who took the Lee Test of Geometric Aptitude, only three took the Minnesota Paper Form Board Test. Their scores were 30, 38, and 52 in a score range of 20 to 62 out of a possible score of 64. The three scores are included in the total 80. For these 80 pupils the scores on the Minnesota Test have been

correlated with the teacher's first-semester marks in geometry. The distribution of these scores is shown in Table 7. The coefficient of correlation between the teacher's marks and the Minnesota-Test scores is $.32 \pm .07$.[1/]

Table 7. Distribution of Teacher's Geometry Marks and Minnesota-Test Scores for 80 Pupils

Scores on Minnesota Test	Teacher's First-Semester Geometry Marks								
	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10
60-64....							1		1
55-59....				1		1	2		4
50-54....				1	3	1		2	7
45-49....		2		2	4	4	1	1	14
40-44....		1	1	3	7	1	3		16
35-39....	1	2	2	4	6	3	3		21
30-34....				2	3	1	1		7
25-29....			2	2			1		5
20-24....	1		1		3				5
Total....	2	5	6	15	26	11	12	3	80

Achievement-test scores and Minnesota-Test scores:-- Of the 80 pupils who took the Minnesota Test only 76 took the achievement test at the end of the first semester.

1/See appendix, p. 50.

Four were absent and took a make-up test later. The Minnesota-Test scores have been correlated with these achievement-test scores. The distribution of these scores is shown in Table 8. The coefficient of correlation between the achievement-test scores and the Minnesota-Test scores is $.36 \pm .07$.[1/]

Table 8. Distribution of Achievement-Test Scores and Minnesota-Test Scores for 76 Pupils

Scores on Minnesota Test	Achievement-Test Scores										
	0 9	10 19	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10	11	12
60-64....									1		1
55-59....							1	1		1	3
50-54....					2	2			1	1	6
45-49....			1	1	3	1		4	1	2	13
40-44....	1	1	1	3	2	3	1		3	1	16
35-39....	1		4	3	3	4	2	2	2		21
30-34....			1			4	1		1		7
25-29....			3		1				1		5
20-24....		1	1			2					4
Total....	2	2	11	7	11	16	5	7	10	5	76

These values of r show a very slight correlation between the teacher's marks and the Minnesota-Test scores and between the achievement-test scores and the Minnesota-

1/See appendix, p. 51.

Test scores. It is usually agreed that the correlation between a mechanical ability test and a mental ability test does not tend to be as high as the correlation between two tests of mental ability.[1] The test manual, for instance, states that the test is predictive of the ability to learn descriptive geometry and quotes a correlation of .32, which by chance is the same value of r obtained in this paper between the Minnesota-Test scores and the teacher's marks in demonstrative geometry. The test manual does not consider demonstrative geometry.

In this school system there is a good technical high school. The majority of the boys with a high degree of mechanical aptitude who would study geometry with mechanical interest attend the technical high school. None of these tenth-grade boys are included in this paper. The great majority of the pupils in the three classes considered here study geometry because it is required in the college course. This fact may have some bearing on the value of r.

On the basis of these 80 scores alone the Minnesota Test cannot be considered an adequate instrument for predicting success or failure in tenth-grade geometry. A more significant value of r might result if the Minnesota-Test scores were obtainable for all the tenth-grade pupils

1/Garrett, op. cit., p. 343.

about to begin the study of geometry, regular divisions, honor divisions, and technical school divisions, to be correlated with the teachers' first-semester marks.

Intelligence Test

In the high school in which this study was made the Pintner General Ability Test-Form A is administered by the Testing Department to all pupils during their first year in the school. The I.Q.s are not disclosed to the teachers so that they cannot influence the teachers' marks. It is the duty of the deans and masters to study the grammar-school records, the I.Q.s, and the high-school achievement of all pupils and to advise the pupils under their jurisdiction. The I.Q.s used in this paper were given to the geometry teacher after the entire-year geometry marks had been completed.

Of the six pupils whose I.Q.s are above 140, two were not in the honor division because it is restricted to tenth-grade pupils who attended the same school the previous year; two others were boys who professed no interest in mathematics and who got only a passing mark in ninth-grade algebra; the two remaining pupils were boys who had so many stronger interests, such as music and athletics, that it seemed wiser not to burden them with the extra work in the honor division.

<u>Teachers' geometry marks and intelligence quotients</u>.--The I.Q.s of these 98 pupils have been correlated with the teachers' first-semester geometry marks, distributed as shown in Table 9, with the exception of seven pupils who were repeating geometry. For these pupils the failing

Table 9. Distribution of Teachers' Geometry Marks and Intelligence Quotients for 98 Pupils

I.Q.	Teachers' First-Semester Geometry Marks								
	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10
150-159..					2		1		3
140-149..				1		1		1	3
130-139..				1	2	1	3		7
120-129..			4	3	5	5	3		20
110-119..	1	3	3	4	9	3	2	1	26
100-109..		1		8	6	1	1		17
90- 99..		2	3	3	8	1			17
80- 89..		1	1	1					3
70- 79..	1			1					2
Total....	2	7	11	22	32	12	10	2	98

marks of the preceding year were used as it is precisely the original success or failure in geometry that is of interest. The I.Q. is not affected by the repetition of geometry. On the other hand when computing the correlation between the Lee-Test scores and the first-semester

geometry marks [1] and between the Minnesota-Test scores and the first-semester geometry marks,[2] the passing marks of the repeated semester were used since all the factors, Lee-Test scores, Minnesota-Test scores, and repeated-semester marks were affected by the knowledge of geometry assimilated in the preceding year. The coefficient of correlation between the teachers' marks and the I.Q.s is $.41 \pm .05$.[3] There is then a positive relationship but it is not of very high degree. The following interpretation is given by Garrett:[4] "...., the correlation must be .70 or more between general intelligence measures and school grades ... to be considered high, since r's in this field usually run from .40 to .60." An r of .40 has only 8 per cent efficiency in predicting.

Achievement-test scores and intelligence quotients.-- Of the 98 pupils in Table 9 only 75 took the achievement test at the end of the first semester receiving scores as in Table 10. The coefficient of correlation between the achievement-test scores and the I.Q.s is $.46 \pm .06$.[5] This

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1/See p. 15.

2/See p. 21.

3/See appendix, p. 52.

4/Garrett, loc. cit.

5/See appendix, p. 53.

r has an efficiency of 11% in prediction. There is a significant relation between the test scores and the I.Q.s, slightly higher than between the semester marks and the I.Q.s. The I.Q. alone could not be used as the only basis of prediction. This is probably due to the composition of intelligence tests. ".... the nature of their content may

Table 10. Distribution of Achievement-Test Scores and Intelligence Quotients for 75 Pupils

I.Q.	Achievement-Test Scores										Total
	0 9	10 19	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	
1	2	3	4	5	6	7	8	9	10	11	12
150-159..						2			1		3
140-149..									1	1	2
130-139..						1		4	1		6
120-129..	1		2		2	1	1	2	3	2	14
110-119..		1	2	3	2	7	1	2	2	2	22
100-109..		1	5		2	1	1		1		11
90- 99..	1		2	4	3	2	1		1		14
80- 89..				1							1
70- 79..		1			1						2
Total...	2	3	11	8	10	14	4	8	10	5	75

largely be comprehended under the two major language systems of our culture: the verbal and the mathematical."1/

1/H. H. Remmers and N. L. Gage, Educational Measurement and Evaluation. Harper and Brothers. New York, 1943, p. 298-299.

The I.Q. combines the scores and hides any comparison between the two. Of three pupils with the same I.Q. one may excel in verbal, one in mathematical, and one may be balanced in both fields. A test of mathematical ability, such as the Lee Test of Geometric Aptitude, gives a score based on the special mental ability rather than general mental ability.

It would seem from Table 9 that a line of demarcation may be determined - pupils below a certain I.Q. will very probably fail geometry. According to this table the five pupils with I.Q. below 90 failed. Of course the work of five pupils does not constitute a law. But if records are kept year after year it seems probable that there will accumulate a list of pupils with I.Q.s below a critical one who invariably failed. This of course is not confined to geometry. It would be of interest to inquire what the five pupils with I.Q. below 90 achieved in other subjects and why their parents wish them to attend college.

Algebra Marks

The teachers' ninth-grade algebra marks (the yearly average) were procured for 105 pupils after the tenth-grade geometry marks were recorded. The other eight pupils in this paper were transferred from schools with different marking systems; their marks had not yet been transposed. For four pupils who had failed ninth-grade

algebra and passed it in their tenth grade an average of the failing ninth-grade mark and the passing tenth-grade mark was used. It is of interest to note that very few pupils who repeat ninth-grade algebra take plane geometry in the eleventh grade. Of the four in this study three failed the first semester of geometry. The one pupil who passed was a post-graduate pupil, more mature than the customary geometry pupils, who came back to high school to try to get enough credits to enter college. Of the 105 recorded ninth-grade algebra marks, 78 were given by 6 different teachers in the school in which this study was made. The remaining 27 pupils came from at least 15 different schools. Only 12 pupils had the same teacher in ninth-grade algebra and tenth-grade geometry.

As noted before,[1] the honor division is restricted to tenth-grade pupils who attended the same school the previous year. Of the 12 pupils with algebra marks above 80, as listed in Table 11, five were not in the honor division because they were eleventh-grade pupils, four had taken algebra in a different school, one had started in the honor division but transferred to a regular division in November, the last two were girls who were not too interested in mathematics and preferred the regular division.

1/See p. 25.

Teachers' geometry marks and algebra marks.-- These algebra marks have been correlated with the first-semester geometry marks. It can be seen from Table 11 that of the 12 pupils with algebra marks above 80 mentioned in the

Table 11. Distribution of Teachers' Geometry Marks and Ninth-Grade Algebra Marks for 105 pupils

Algebra Marks	Teachers' Geometry Marks											
	21 27	28 34	35 41	42 48	49 55	56 62	63 69	70 76	77 83	84 90	91 97	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
90-92..				1					1	2	2	6
87-89..												0
84-86..	1						1	1				3
81-83..					2					1		3
78-80..				1		1	3	5	1	2		13
75-77..					1		5	2	2			10
72-74..		1			3	1	2	1				8
69-71..	1		1		2	1	4	1	1	1		12
66-68..			1	1	1	6	2					11
63-65..		1	1	3	4	2	4			1		16
60-62..	1		2	3	3	7	6	1				23
Total..	3	2	5	9	16	18	27	11	5	7	2	105

preceding paragraph four received a geometry mark below 60- the passing mark. Three received their algebra marks in different schools so that it is quite possible that the marks were not transposed correctly. The fourth is one of the girls who expressed a desire not to go into the honor

division - she knew her limitations.

The coefficient of correlation between the algebra marks and geometry marks is $.43 \pm .05$.[1/] This *r* has an efficiency of 10 per cent for prediction. There is, then, a definite relationship between the algebra marks and geometry marks. But the coefficient of correlation is not high enough to warrant the use of the algebra mark as the only instrument of prediction. Comparison of an analysis of the abilities required for success in algebra and a similar analysis for geometry may reveal enough difference in the requisite abilities to account for part of the low correlation.

Achievement-test scores and algebra marks.-- Of these 105 pupils only 82 took the achievement test given at the end of the first semester. The scores are shown in Table 12. The coefficient of correlation between the algebra marks and the achievement-test scores is $.51 \pm .05$.[2/] This again shows that, although the algebra marks alone cannot be used authoritatively to predict success in geometry, still there is a definite relationship between the algebra marks and the geometry achievement-test scores so that the algebra marks can be used as one instrument for prediction.

1/See appendix, p. 54.

2/Ibid, p. 55.

Multiple Coefficients of Correlation

Now the four instruments for prediction have been correlated with the teachers' first-semester geometry marks listed in Table 13 and none yielded a coefficient of correlation high enough to warrant its use as a single

Table 12. Distribution of Achievement-Test Scores and Ninth-Grade Algebra Marks for 82 Pupils

Algebra Marks	Achievement-Test Scores										
	0 9	10 19	20 29	30 39	40 49	50 59	60 69	70 79	80 89	90 99	Total
1	2	3	4	5	6	7	8	9	10	11	12
90-92..								1	3	1	5
87-89..											0
84-86..					1	1					2
81-83..				1	1				1		3
78-80..							3	4	2	2	11
75-77..			1	1		3	1	1	2		9
72-74..		1		1	2	2					6
69-71..		1	2	2		1	1	1		1	9
66-68..			1	1	4	2					8
63-65..	1	1	2		1	3		1	2		11
60-62..	1		5	3	2	5	1	1			18
Total..	2	3	11	9	11	17	6	9	10	4	82

instrument for prediction. Therefore the multiple coefficients of correlation have been computed using the I.Q.s, the ninth-grade algebra marks, the Lee-Test scores, and the teachers' marks in first-semester tenth-grade

geometry to determine if two or more scores will constitute a better instrument for prediction than one score. The Minnesota-Test scores have not been used as their correlation with the geometry mark is slight. The teachers' mark has been used as the measure of achievement rather than the test mark because the teachers' mark determines the pupils' success or failure in the course.

Geometry marks, intelligence quotients, and Lee Test scores.-- The R between the actual first-semester geometry marks and the marks estimated by means of the regression equation made up of I.Q.s and Lee-Test scores

Table 13. Correlation between Single Prediction Instrument and Teachers' Geometry Marks

Instrument	Correlation with Geometry
Lee Test.............	.63 ± .04
Ninth Grade Algebra...	.43 ± .05
Intelligence Test.....	.41 ± .05
Minnesota Test........	.32 ± .07

is .64.[1] This is almost the same coefficient as obtained for the Lee Test score alone; therefore the extra work involved in using both I.Q.s and Lee-Test scores is

[1] See appendix for calculation of additional coefficient of correlation, p. 56.

unnecessary.

Geometry marks, algebra marks, and Lee Test scores.-- The R between the actual first-semester geometry marks and the marks estimated by means of the regression equation made up of ninth-grade algebra marks and Lee-Test scores is .68.[1/]

Geometry marks, intelligence quotients, algebra marks, and Lee Test scores.-- The R between the actual first-semester geometry marks and the marks estimated by means of the regression equation made up of I.Q.s, ninth-grade algebra marks, and Lee-Test scores is also .68.[2/] It is unnecessary to use three instruments of prediction since two give the same result.

1/See appendix for calculation of additional coefficient of correlation, p. 57.

2/Ibid, p. 58.

CHAPTER III

CONCLUSION

Use of Algebra Marks and Lee Test Scores

Highest correlation with algebra marks and Lee-Test scores.-- Since .68 is the highest coefficient of correlation obtained, the ninth-grade algebra marks and the Lee-Test scores will be used in initiating the project of predicting success in tenth-grade geometry. Having determined the regression equations from existing records, the adviser can estimate the geometry mark and each year advise the new crop of pupils as soon as they have taken the Lee Test in September or perhaps at the end of the ninth grade. The regression equations can be readjusted as more data are accumulated.

Factors influencing both algebra marks and geometry marks.-- At present the ninth-grade algebra mark is the sole criterion in determining which pupils may study geometry. The coefficient of correlation is only .43. The algebra mark does not reflect too greatly aptitude for geometry. The algebra mark does however reflect intelligence, interest in mathematics, study habits, health, home cooperation, influence of extracurricular interests - all

of which will in turn affect the geometry mark. The added interest in and aptitude for geometry is brought in by the Lee Test.

The algebra mark also represents the result of good or poor teaching which is equally important to pupils who are studying geometry. But the improvement of the teaching methods is not within the scope of this paper.

<u>Probability of estimated mark dependent on individual pupils</u>.-- As the <u>r</u> of .68 is not perfect correlation, there are two further points to consider. The adviser must bear in mind when planning the pupil's schedule that the estimated mark is a probability. With some pupils the possibility of failure will offer a challenge so that they will work harder and succeed. With other pupils of different temperaments the possibility of failure will discourage them so that they will give up. Throughout the years by comparing results the adviser may derive a division into three groups of estimated marks obtained from the regression equations made from the ninth-grade algebra marks and Lee-Test scores. Above a certain score pupils have always passed geometry; below a certain score they have always failed; and between the two scores some pupils have failed and some have passed. The majority of pupils are influenced by the results obtained by other pupils.

Further Study

<u>Reading ability</u>.-- With an r of .68 the problem is not completed. It is necessary to continue the search for predictive instruments. One that should prove of value in predicting success in geometry is a test of reading ability. If school finances prevent the purchase of such tests, the English mark may be correlated with the geometry mark for possible use in prediction. But as the test of reading ability would be of use in all subjects, such an expenditure would probably be approved.

<u>Instructional value</u>.-- Whatever the estimated geometry mark may be, a comparison between it and the marks earned by the pupil month by month affords the teacher an opportunity to study herself and her teaching habits, and the pupil and his study habits in an effort to account for discrepancies. Such a study will result not only in discovering further predictive instruments but in better teaching and better learning.

APPENDIX

First Semester Achievement Test

Part I

1. If angle A is the vertex angle of isosceles triangle ABC and if angle B has 52 degrees, how many degrees in the exterior angle at A?

2. Can you draw a triangle with sides 16, 25, and 12 inches respectively? Yes or No.

3. Name the longest side in triangle ABC if angle A is greater than angle B and angle C has 60 degrees.

4. The sum of the interior angles of an octagon is 540 degrees. True or False.

5. In a parallelogram ABCD, angle A has 37 degrees. How many degrees in angle B?

6. An angle which is 3 times its supplement has how many degrees?

7. In right triangle ABC, angle A is twice angle B. If AB has 15 inches, AC has either ___ or ___ inches. Give both answers.

8. How many sides in an equiangular polygon with an exterior angle of 30 degrees?

9. Two triangles are not necessarily congruent if 3 ___ of one are equal to the corresponding 3 parts of the other.

10. In a triangle the line from a vertex perpendicular to the opposite side extended if necessary is called ____.

11. If the diagonals of a parallelogram are unequal but perpendicular, the figure is _______.

12. The size of an angle does not depend on the ____ of its sides.

13. When two adjacent angles are equal and formed by two straight lines only, each angle is _______.

14. The bisectors of two consecutive angles of a parallelogram form an angle of how many degrees?

15. Every polygon has more than 3 sides. True or False.

16. An altitude of a triangle does not always fall within the triangle. True or False.

17. Can you draw a triangle with sides 4, 5, and 9 inches respectively? Yes or No.

18. The hands of the clock at 5 o'clock form an angle of how many degrees?

19. How many diagonals can be drawn from one vertex in a heptagon?

20. Name the shortest side in triangle ABC if angle A is greater than angle B and angle C has 60 degrees.

21. The perimeter of the triangle formed by joining the midpoints of the sides of a triangle is 24 inches. Find the perimeter of the triangle.

22. The lower base of a trapezoid is 16, the line joining the mid-points of the nonparallel sides is 13. How long is the upper base?

23. In parallelogram ABCD if angle A has 37 degrees, how many degrees in angle C?

24. If in triangle ABC, BC is greater than AC, then angle A is greater than angle B. True or False.

25. Is the converse of "Vertical angles are equal" always true? Yes or No.

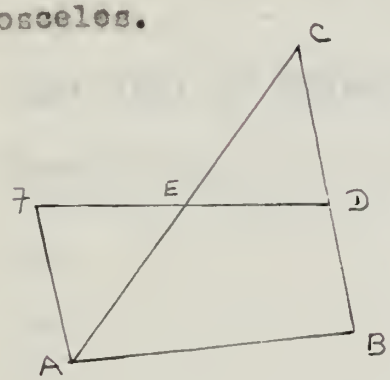
26. If the diagonals of a parallelogram are equal and perpendicular, the figure is ____.

27. If in triangle ABC, AC is greater than BC and the bisectors of angle A and angle B meet at D, is AD greater than, equal to, or less than DB?

28. If AM is a median of triangle ABC and angle AMB is acute, is AC greater than, equal to, or less than AM?

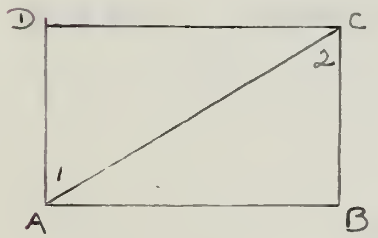
Part II

1. Prove: If the bisector of an angle of a triangle is perpendicular to the opposite side, the triangle is isosceles.

2. 

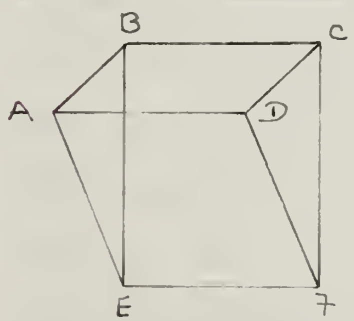
Given:
FD and CA bisect each other

Prove:
$FA \parallel BC$

3. 

Given:
$AD \perp AB$
$BC \perp CD$
$\angle 1 = \angle 2$

Prove:
$DC \parallel AB$

4. 

Given:
ABCD is a parallelogram
ADFE is a parallelogram

Prove:
BCFE is a parallelogram

GEOMETRIC APTITUDE TEST

Total Score ____________

Rating ____________

LEE TEST OF GEOMETRIC APTITUDE—Form A

Devised by Dorris M. Lee,* and J. Murray Lee, Dean, School of Education, State College of Washington, Pullman, Washington.

Name...Age..................................

School...Grade................................

City...Date......................................

Boy or Girl..............How many semesters have you studied Geometry?..........

....

PUPIL'S RECORD

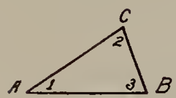
	Possible Score	Pupil's Score	Rating
Test 1.	16		
Test 2.	28		
Test 3.	12		
Test 4.	24		
Total	80		

*Formerly Glendale City Schools, Glendale, California

Published by California Test Bureau
5916 Hollywood Boulevard., Los Angeles 28, California

Test 1

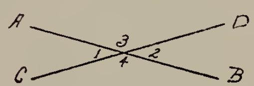
Study the explanations carefully.



The sum of all the angles of a triangle equals 180°.

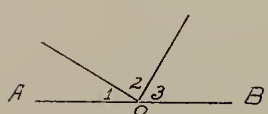
Example—In the triangle ABC, $\angle 1 + \angle 2 + \angle 3 = 180°$

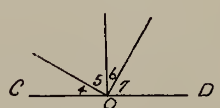
If two straight lines intersect, then the vertical angles formed are equal.



Example—Since lines AB and CD intersect there are two pairs of vertical angles formed, angles 1 & 2 and 3 & 4. Hence $\angle 1 = \angle 2$ and $\angle 3 = \angle 4$.

The sum of all the successive adjacent angles around a point on one side of a straight line through the point is one straight angle or 180°.





Example—$\angle 1 + \angle 2 + \angle 3 = \angle AOB$

$\angle AOB = 180°.$

or $\angle 4 + \angle 5 + \angle 6 + \angle 7 = 180°.$

Test 1—(Continued)

Do the following problems, referring to the Figures A, B, C, and the explanations whenever necessary.

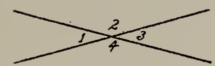


FIG. A

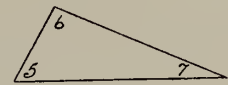


FIG. B

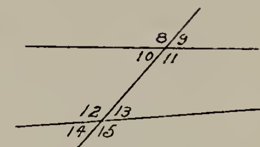


FIG. C

1. In Fig. A, $\angle 1 = 30°$. $\angle 3 =$ ....°
2. In Fig. B, the sum of $\angle 5$, $\angle 6$, and $\angle 7 =$ ....°
3. In Fig. A, $\angle 4 = 150°$. $\angle 2 =$ ....°
4. In Fig. A, $\angle 1$ $\angle 2 =$ ....°
5. In Fig. C, what angle or angles are equal to $\angle 8$? ....°
6. In Fig. B, $\angle 5 + \angle 6 = 145°$, $\angle 7 =$ ....°
7. In Fig. C, $\angle 14 = 45°$, $\angle 12 =$ ....°
8. In Fig. C, $\angle 12 + \angle 13 + \angle 14 + \angle 15 =$ ....°
9. In Fig. B, $\angle 5 = 60°$. $\angle 6 + \angle 7 =$ ....°
10. In Fig. C, $\angle 13 =$ ....°
11. In Fig. B, $\angle 6 =$ ....°
12. In Fig. C, $\angle 8 + \angle 9 + \angle 10 = 230°$, $\angle 9 =$ ....°

STOP HERE! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO!

No. Right	0	1	2	3	4	5	6	7	8	9	10	11	12
Score	0	1	3	4	5	7	8	9	11	12	13	15	16

Test 2

Apples 4 lbs. for 25c	Grapes 7 lbs. for 25c	Peaches 3 lbs. for 20c
Bananas 2 lbs. for 25c	Lemons 3 for 5c	Prunes 2 lbs. for 25c
Cherries 20c a lb.	Raisins 10c a box	Melons 15c each
Grapefruit 6 for 25c	Oranges 3 for 10c	Tomatoes 5c a lb.

Prices of the various fruits and vegetables are listed above. Supply the missing numbers in the following problems as shown in samples A, B, and C.

SAMPLES:

A. 4 lbs. apples costs........*JUST*........as much as 6 grapefruit.

B. A melon cost........*3 TIMES*........as much as a lb. of tomatoes.

C. 1 lb. of prunes costs........½........as much as 7 lbs. of grapes.

Test 2—(Continued)

Do these the same way. Reduce fractional answers to lowest terms.

1. 7 lbs. of grapes cost..............................as much as 4 lbs. of apples.
2. 3 lemons cost..............................as much as a box of raisins.
3. 12 oranges cost..............................as much as 1 lb. of cherries.
4. 8 lbs. of bananas cost..............................as much as 3 lbs. of peaches.
5. A melon costs..............................as much as 2 lbs. of tomatoes.
6. 6 lbs. of prunes cost..............................as much as 18 grapefruit.
7. 1 lb. of peaches costs..............................as much as 1 lb. of cherries.
8. 6 oranges cost..............................as much as 8 lbs. of apples.
9. 4 boxes of raisins cost..............................as much as 9 lemons.
10. A dozen grapefruit costs..............................as much as 3 lbs of tomatoes.
11. 4 lbs. of bananas cost.............................. as much as 1 melon.
12. 2 lbs. of bananas and a box of raisins cost..............................as much as 3 oranges.
13. 6 lbs. of peaches and 3 lemons cost..............................as much as 7 lbs. of grapes.
14. 2 lbs. of cherries and 2 lbs. of prunes cost..............................as much as 3 lbs. of peaches.

STOP HERE! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO!

No. Right	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Score	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28

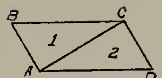


FIG. 1

FIG. 2

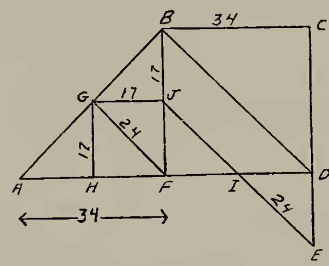
FIG. 3

In geometry, *figures are called by the letters which are at each of their corners. Lines are named by the letters as each end.* For example, the horizontal lines in Figure 1 are BC and AD. *This figure is a parallelogram.* That means that the opposite sides are parallel, that is, run in the same direction. Line AB is parallel to line CD and line BC is parallel to line AD. *The figure is named* ▱ ABCD. Figures 2 and 3 are also parallelograms. *In a parallelogram the opposite sides are equal as well as parallel.* That is, if AB is 10 ft., CD is also 10 ft. Or if BC is 25 ft., AD is also 25 ft.

Figure 1 is divided into 2 triangles by line AC. Triangle 1 is called △ ABC, and triangle 2 is called △ ACD

Perimeter means the distance around a figure, as the perimeter of ▱ ABCD = AB + BC + CD + AD = 10 + 25 + 10 + 25 = 70 ft.

Look at the next figure. You are given the length of some of the lines, find the length of the lines and perimeters asked for and put the answers in the answer column. The numbers on the lines indicate the length of the line between the letters.



Answer Column

1. How long is HF? ....(1)
2. How long is AH? ....(2)
3. How long is BF? ....(3)
4. How long is JI? ....(4)
5. What is the perimeter of ▱ GJIF? ....(5)
6. What is the perimeter of △ GJF? ....(6)
7. How long is BD? ....(7)
8. What is the perimeter of ▱ FBCD? ....(8)
9. How long is DE? ....(9)
10. How long is ID? ....(10)
11. What is the perimeter of △ IDE? ....(11)
12. What is the perimeter of ▱ BJED? ....(12)

STOP HERE! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO!

No. Right	0	1	2	3	4	5	6	7	8	9	10	11	12
Score	0	1	2	3	4	5	6	7	8	9	10	11	12

Perimeter means the distance around an object.
Area is found by multiplying length by width.
Volume is found by multiplying length by width by height.
Do the following problems:

Answer Column

1. What is the area of a board L feet long and W feet wide? ....(1)
2. What is the perimeter of a board L feet long and W feet wide? ....(2)
3. If a rectangle A feet long and B feet wide was divided into two equal parts, what would be the area of one part? ....(3)
4. What is the area of a rectangle that is formed by placing two equal squares of paper side by side? The side of the square of paper is S inches long. ....(4)
5. What is the perimeter of the rectangle described in problem 4? ....(5)
6. If from a rectangle L feet long and W feet wide a square B feet wide is cut, what is the area of the remaining figure? ....(6)
7. From a piece of cloth C feet long and D feet wide, a piece A feet long and D feet wide is cut, what is the area of the remaining piece? ....(7)
8. From a square of tin, the side of which is X, two smaller squares, each Y feet long, have been cut. What is the present area of the piece of tin? ....(8)
9. What is the volume of a cube if E is the length of one edge? ....(9)
10. Each face of a cube is a square. If the edge of a cube is E, the area of one face is E^2. Write a formula for the total surface of the cube. ....(10)
11. If two cubes, the edge of each E feet long, are placed side by side, what would be the volume of the resulting rectangle solid? ....(11)
12. A rectangle 2W feet long and X feet wide is placed beside a rectangle Y feet long and X feet wide so that the width coincide. What is the area of the resultant rectangle? ....(12)

STOP HERE!

No. Right	0	1	2	3	4	5	6	7	8	9	10	11	12
Score	0	2	4	6	8	10	12	14	16	18	20	22	24

43

SERIES AA

Score Percentile

REVISED MINNESOTA PAPER FORM BOARD TEST

Prepared by R. Likert and Wm. H. Quasha
New York University *

Fill in the blanks below (name, age, etc.)

BUT DO NOT TURN OVER OR OPEN THE BOOKLET UNTIL THE SIGNAL IS GIVEN

PRINT WITH CAPITAL LETTERS

My Name ....
(Last) (First) (Middle)

School or Institution ....

Today's Date ....
(Month) (Day) (Year)

Instructor's or Foreman's Name..

Age Last Birthday .... Sex ....

The Date of My Birth..
(Month) (Day) (Year in which you were born)

Grade I Am Now In: Grammar School 1 2 3 4 5 6 7 8 High School 1 2 3 4 College 1 2 3 4 5 6 7
(Put a circle around the grade you are now in)

Or Department ....

....

....

DO NOT TURN OVER OR OPEN THE BOOKLET UNTIL THE SIGNAL IS GIVEN

The parts in most of the problems are taken from the Minnesota Paper Form Board Tests which appear in Paterson, Donald G., Elliott, Richard M., Anderson, L. Dewey, Toops, Herbert A., and Heidbreder, Edna, "Minnesota Mechanical Ability Tests," University of Minnesota Press, pages 94-101. Used by permission.

READ THE FOLLOWING DIRECTIONS VERY CAREFULLY WHILE THE EXAMINER READS THEM ALOUD

Look at the problems on the right side of this page. You will notice that there are eight of them, numbered from 1 to 8. Notice that the problems go DOWN the page.

First look at Problem 1. There are two parts in the upper left-hand corner. Now look at the five figures labelled A, B, C, D, E. You are to decide which figure shows how these parts can fit together. Let us first look at Figure A. You will notice that Figure A does **not** look like the parts in the upper left-hand would look when fitted together. Neither do Figures B, C, or D. Figure E **does** look like the parts in the upper left-hand corner would look when fitted together, so E is PRINTED in the square above $\boxed{1}$ at the top of the page.

Now look at Problem 2. Decide which figure is the correct answer. As you will notice, Figure A is the correct answer, so A is printed in the square above $\boxed{2}$ at the top of the page.

The answer to Problem 3 is B, so B is printed in the square above $\boxed{3}$ at the top of the page.

In Problem 4, D is the correct answer, so D is printed in the square above $\boxed{4}$ at the top of the page.

Now do Problems 5, 6, 7, and 8.

PRINT the letter of the correct answer in the square above the number of the example at the top of the page.

DO THESE PROBLEMS NOW.

If your answers are not the same as those which the examiner reads to you, RAISE YOUR HAND.

DO NOT OPEN THE BOOKLET UNTIL YOU ARE TOLD TO DO SO.

Some of the problems on the inside of this booklet are more difficult than those which you have already done, but the idea is exactly the same. In each problem you are to decide which figure shows the parts correctly fitted together. **Sometimes the parts have to be turned around, and sometimes they have to be turned over in order to make them fit.** In the square above $\boxed{1}$ write the correct answer to Problem 1; in the square above $\boxed{2}$ write the correct answer to Problem 2, and so on with the rest of the test. Start with Problem 1, and go DOWN the page. After you have finished one column, go right on with the next. **Be careful not to go so fast that you make mistakes. Do not spend too much time on any one problem.**

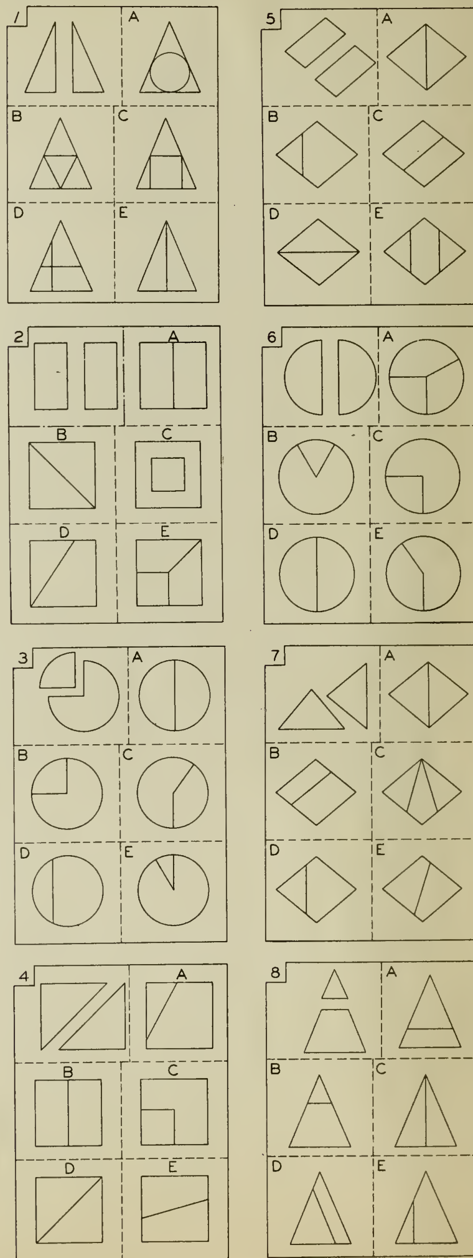
PRINT WITH CAPITAL LETTERS ONLY.

MAKE THEM SO THAT ANYONE CAN READ THEM.

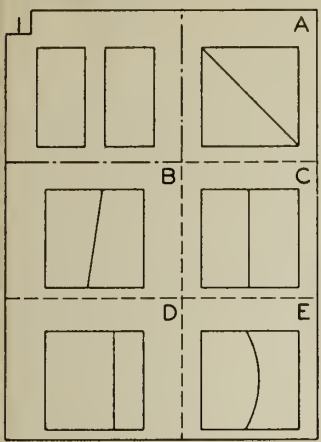
DO NOT OPEN THE BOOKLET BEFORE YOU ARE TOLD TO DO SO.

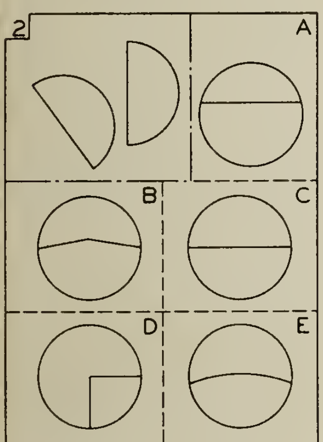
YOU WILL HAVE EXACTLY 20 MINUTES TO DO THE WHOLE TEST.

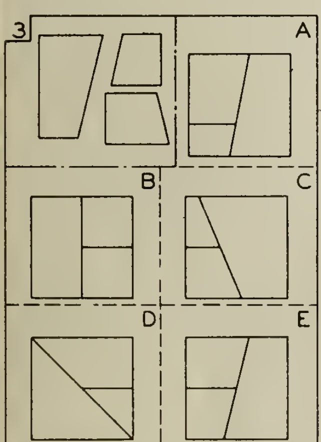
E	A	B	D				
1	2	3	4	5	6	7	8

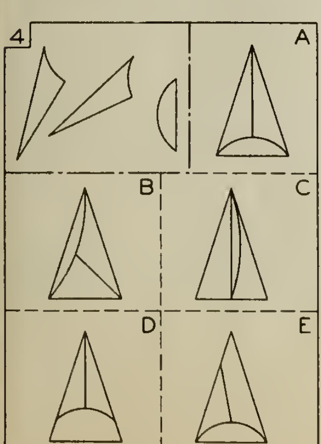


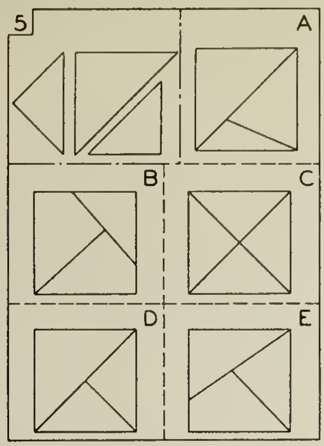
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

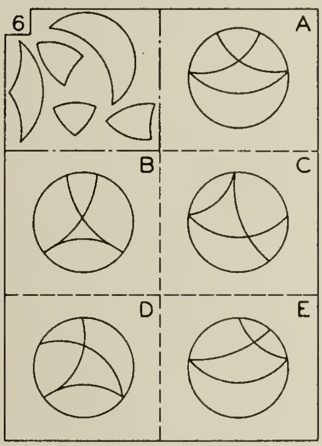


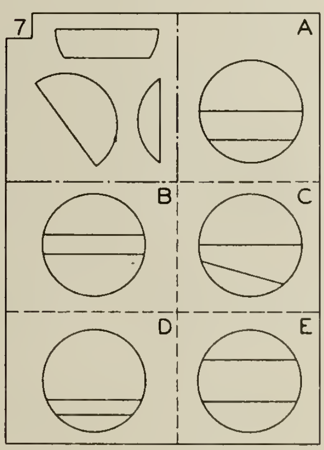


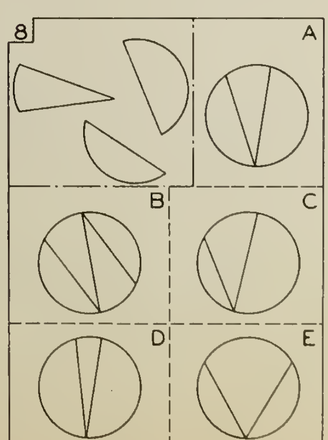


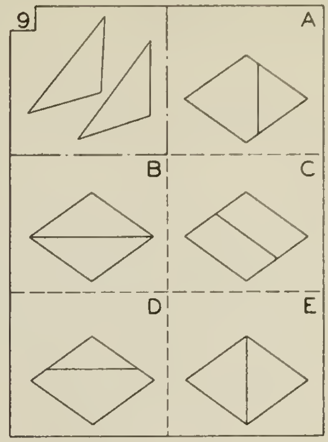


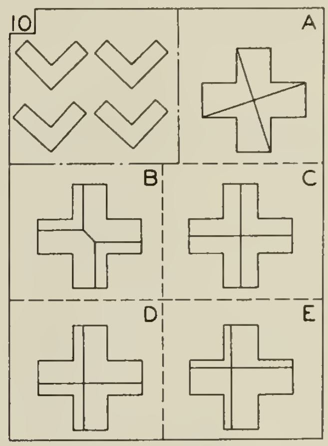


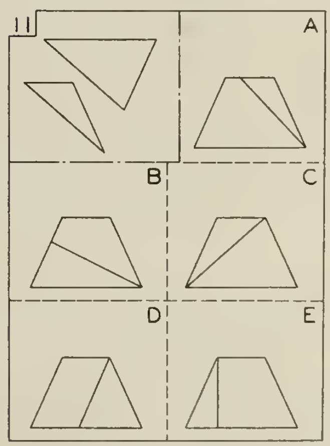


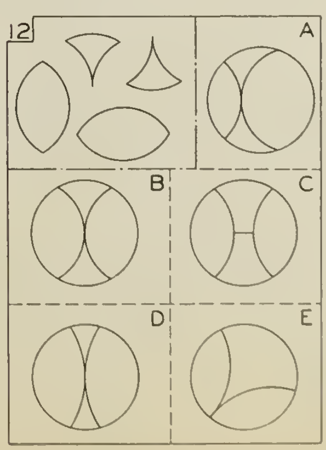


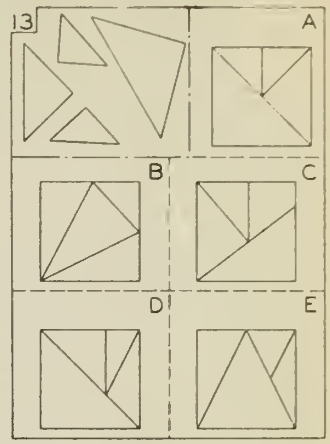


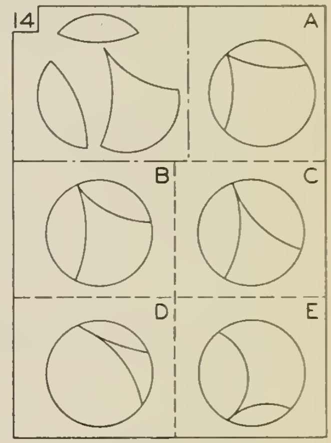


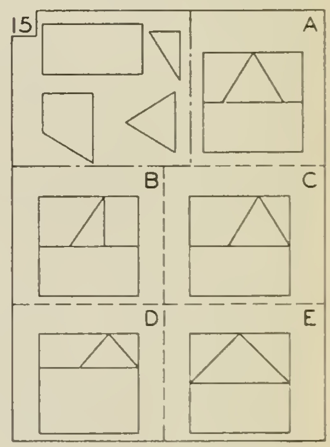


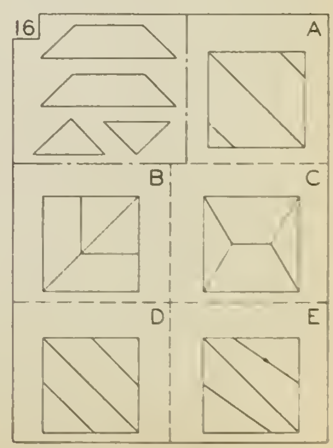






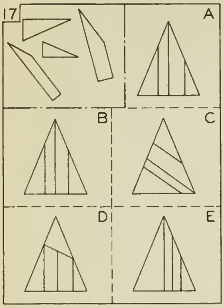


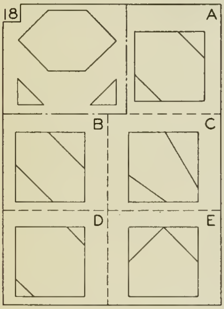


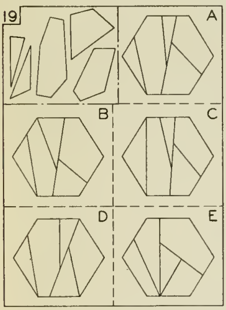


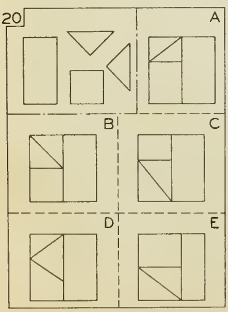
Go on with page 3.

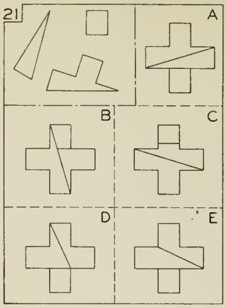
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

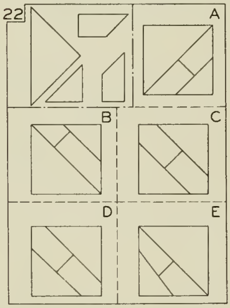


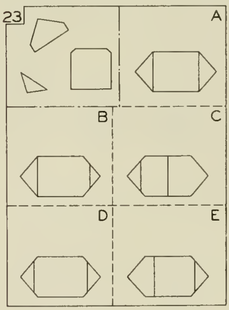


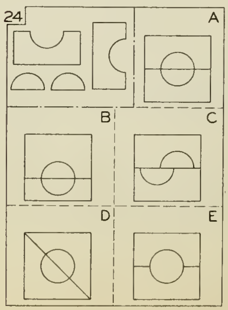


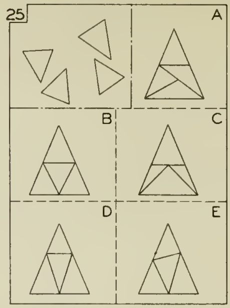


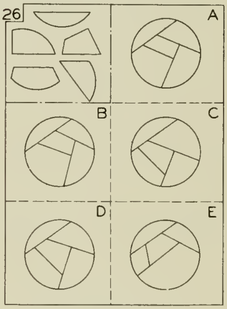


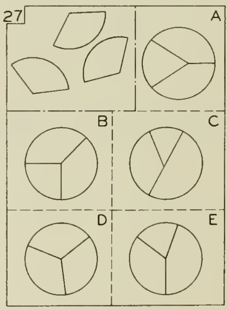


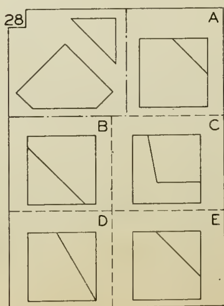


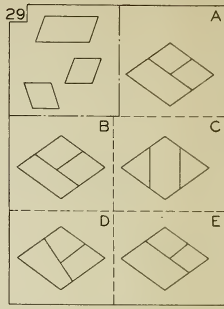


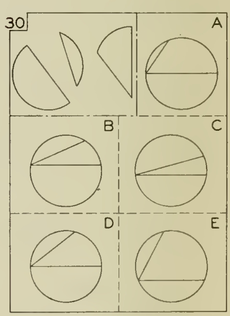


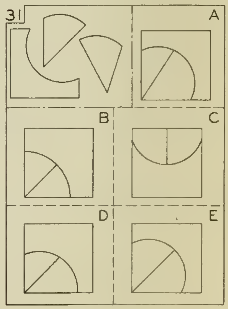


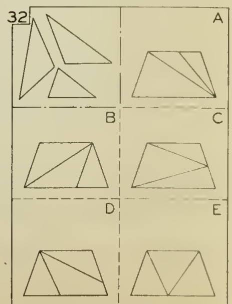






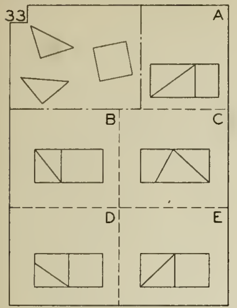


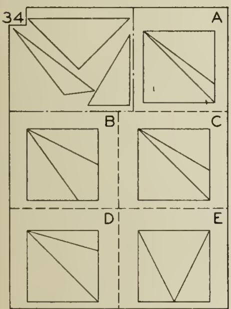


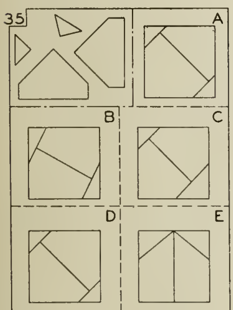


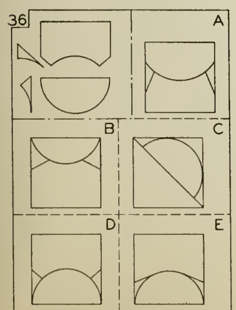
Go on with page 4.

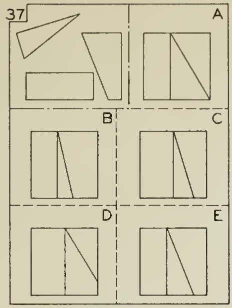
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48

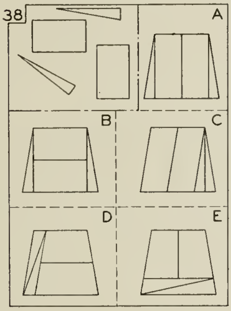


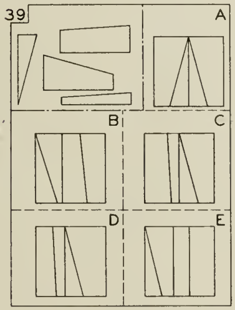


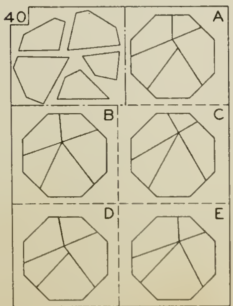


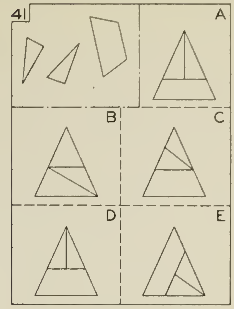


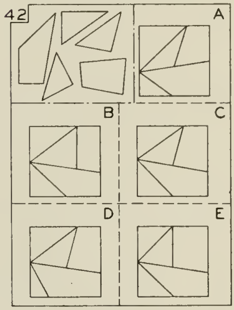


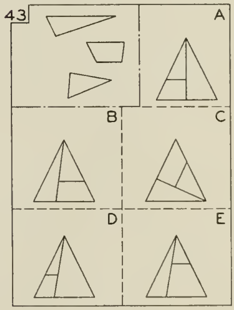


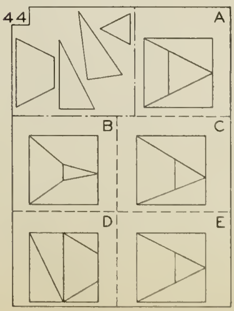


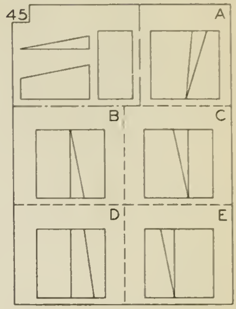


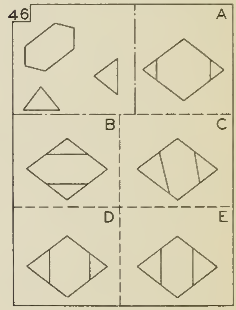


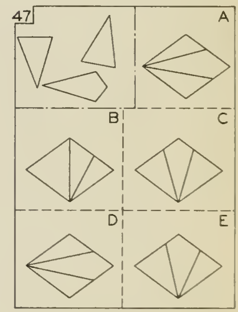


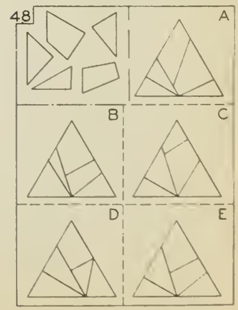






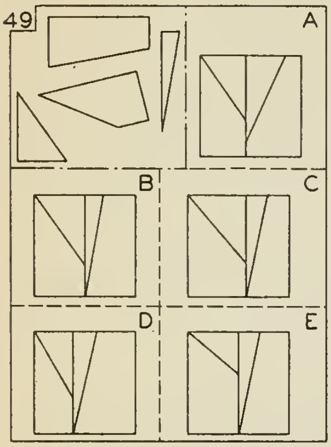


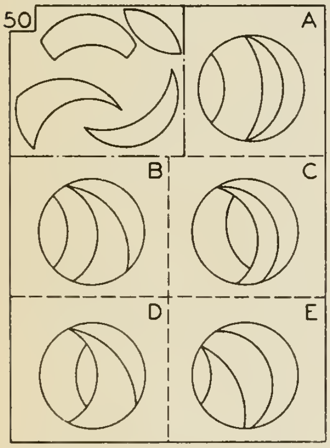


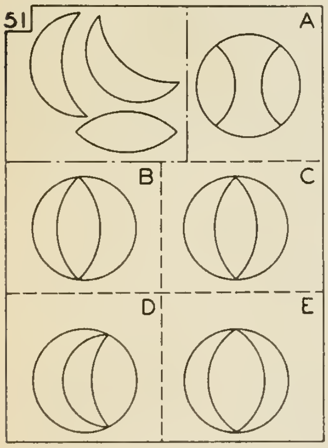


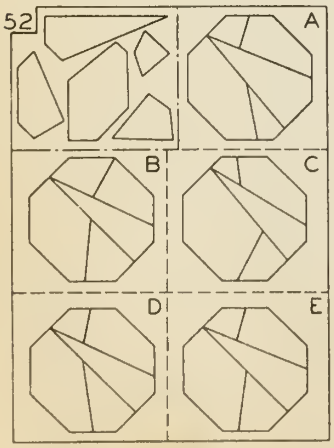
Turn over and go on with page 5.

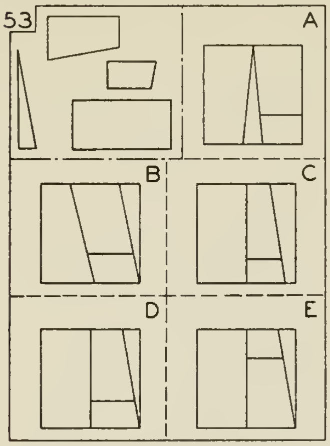
49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64

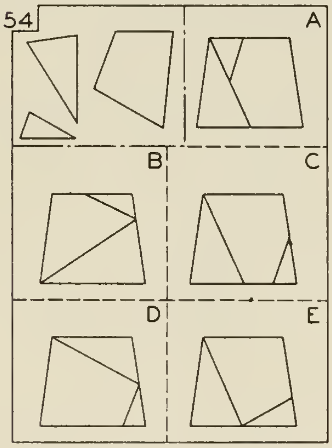


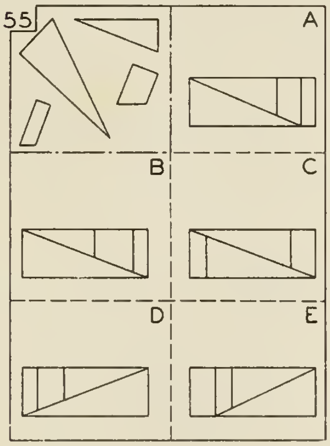


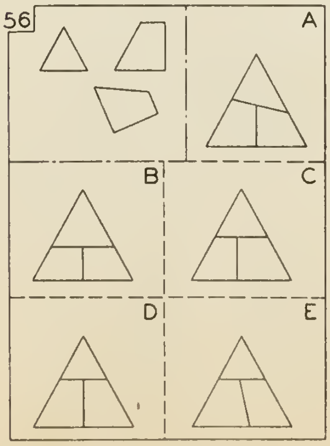


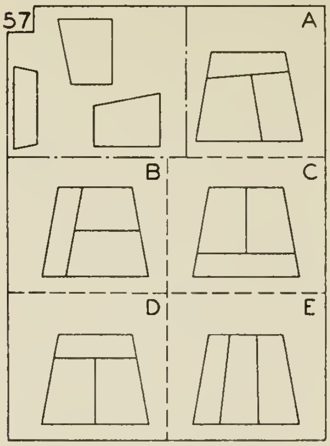


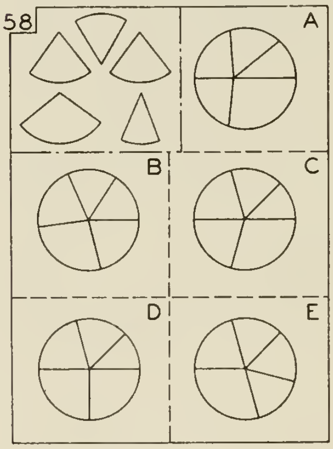


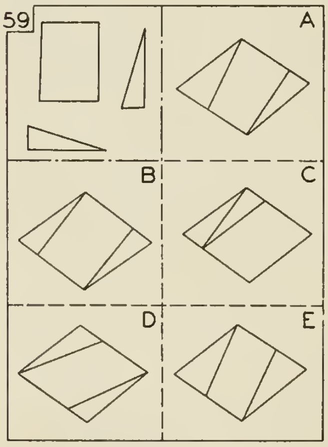


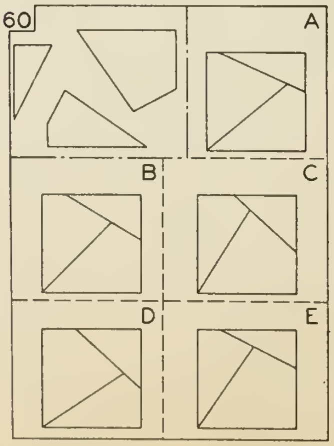


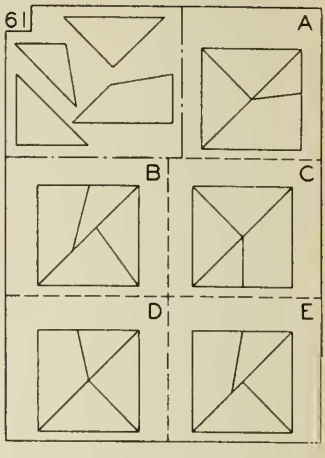


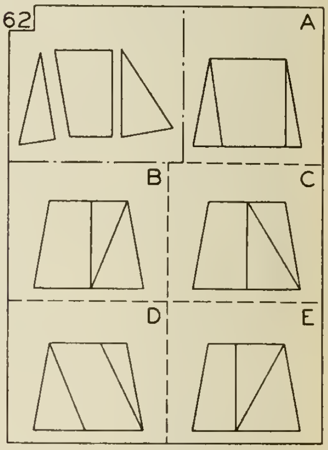


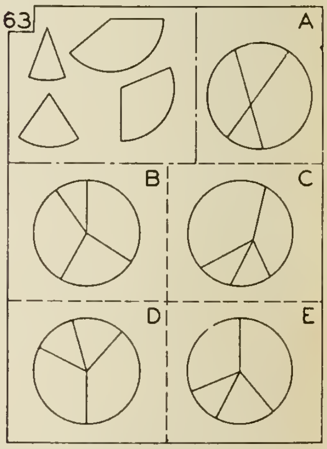


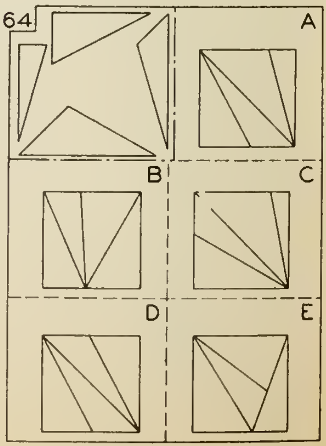












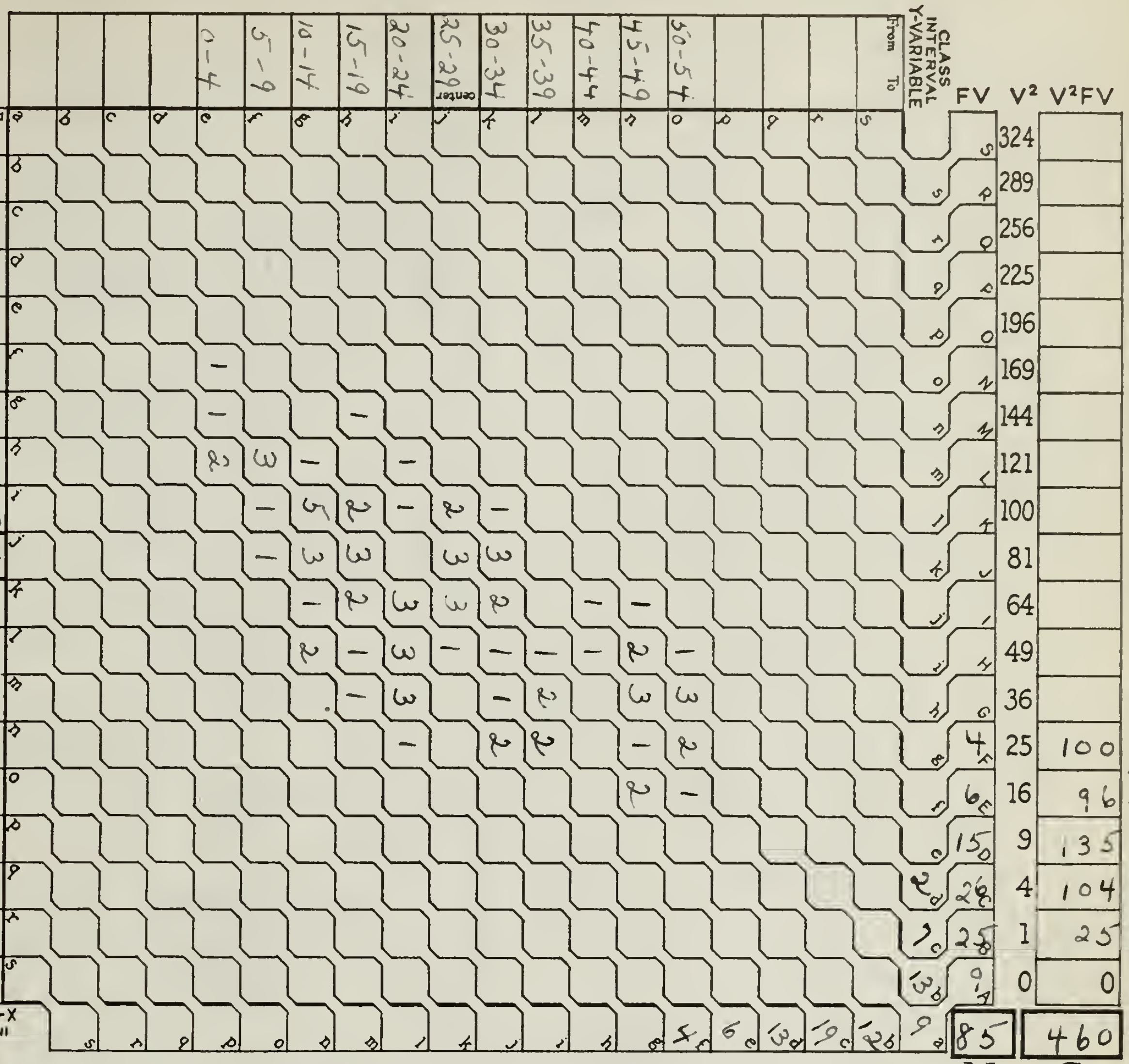
If you finish before you are told to stop, go back and make sure that every answer is right.

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

Correlation between Achievement Test - Part I - Score (x) and Achievement Test - Part II - Score (y) r_{xy} = .72 ± .03



Class interval X-variable	FX	X	XFX	X^2	X^2FX
0–4	1	3	3	9	9
5–9	2	2	4	4	8
10–14	7	1	7	1	7
15–19	12	0	A 188		0
20–24	13	1	13	1	13
25–29	13	2	26	4	52
30–34	13	3	39	9	117
35–39	13	4	52	16	208
40–44	8	5	40	25	200
45–49	3	6	18	36	108

N 85 B 14 C 722

Y	FY	YFY	Y^2	Y^2FY
10			100	
9			81	
8			64	
7			49	
6	7	42	36	252
5	9	45	25	225
4	2	8	16	32
3	5	15	9	45
2	10	20	4	40
1	9	9	1	9
0	12	D 139		0
1	10	10	1	10
2	12	24	4	48
3	5	15	9	45
4	4	16	16	64
5			25	
6			36	
7			49	
8			64	

N 85 E 65 F 770

G 460 N 85

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

Calculation			
A	188	H^2	30276
B	14	$H^2\div N$	356
A-B	174 H	C	722
D	139	$C-H^2\div N$	366 P
E	65	J^2	5476
D-E	74 J	$J^2\div N$	64.4
H	174	F	770
HJ	12876	$F-J^2\div N$	705.6 Q
HJ÷N	151.5		
2HJ÷N	303 K		

Numerator		Denominator	
C	722	PQ	258249.6
F	770	$\sqrt{PQ}$	508.2
C+F	1492	$2\sqrt{PQ}$	1016.4 S
G	460		
C+F-G	1032 L		
K	303		
L-K	729 M	M÷S (Coef. of Cor.)	.72 r_{xy}

To find P.E.$_r$

r^2	.5184	
$1-r^2$	.4816	T
$\sqrt{N}$	9.22	W
T÷W	.052	Z
.6745 Z	.03	P.E.$_r$

To find σ_x: P÷N a; $\sqrt{a}$ b; C.I.$_x$ c; b×c σ_x

To find σ_y: Q÷N d; $\sqrt{d}$ e; C.I.$_y$ f; e×f σ_y

To find M_x: d HCI.$_x$; g÷N h; f M.V.$_x$ i; i+h M_x

To find M_y: g JC.I.$_y$ k; k÷N m; i M.V.$_y$ n; n+m M_y

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40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
																																		108 1944	90 1620	72 1296	54 972	36 648	18 324
																																		102 1734	85 1445	68 1156	51 867	34 578	17 289
																																	112 1792	96 1536	80 1280	64 1024	48 768	32 512	16 256
																																120 1800	105 1575	90 1350	75 1125	60 900	45 675	30 450	15 225
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									248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64
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240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
320 2560	312 2496	304 2432	296 2368	288 2304	280 2240	272 2176	264 2112	256 2048	248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19[illegible]
69	4761	139	19[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

Correlation between Achievement Test Scores (x) and Teacher's Geometry Marks (y) r_{xy} = .78 ± .03

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

X-variable

Class interval X-variable	FX	X	XFX	X^2	X^2FX
0–9	2	4	8	16	32
10–19	3	3	9	9	27
20–29	11	2	22	4	44
30–39	10	1	10	1	10
40–49	11	0	A 125	0	0
50–59 (center)	17	1	17	1	17
60–69	6	2	12	4	24
70–79	9	3	27	9	81
80–89	11	4	44	16	176
90–99	5	5	25	25	125
Totals	N 85		B 49		C 536

Y-variable

Class interval Y-variable	FY	Y	YFY	Y^2	Y^2FY
21–27	2	5	10	25	50
28–34	1	4	4	16	16
35–41	4	3	12	9	36
42–48	5	2	10	4	20
49–55	11	1	11	1	11
56–62	14	0	D 103	0	0
63–69 (center)	21	1	21	1	21
70–76	10	2	20	4	40
77–83	8	3	24	9	72
84–90	7	4	28	16	112
91–97	2	5	10	25	50
Totals	N 85		E 47		F 428

FV, V^2, V^2FV: 25; 16; 45; 84; 30; 0 — N 85, G 200

Calculation

A	125	
B	49	
A−B	76	H
D	103	
E	47	
D−E	56	J
H	76	
HJ	4256	
HJ÷N	50	
2HJ÷N	100	K
H^2	5776	
C	536	
$H^2\div N$	68	
$C-H^2\div N$	468	P
J^2	3136	
F	428	
$J^2\div N$	37	
$F-J^2\div N$	391	Q

Numerator

C	536	
F	428	
C+F	964	
G	200	
C+F−G	764	L
K	100	
L−K	664	M

Denominator

PQ	182988	
$\sqrt{PQ}$	427.77	
$2\sqrt{PQ}$	855.54	S

Coef. of cor.: M÷S = .78 r_{xy}

To find P.E.r

r^2	.6084	
$1-r^2$	.3916	T
$\sqrt{N}$	9.22	W
T÷W	.0425	Z
.67Z	.03	P.E.r

To find σ_x: P÷N (a), $\sqrt{a}$ (b), C.I.$_x$ (c), b×c — σ_x

To find σ_y: Q÷N (d), $\sqrt{d}$ (e), C.I.$_y$ (f), e×f — σ_y

To find M_x: d HCI.$_x$, e g÷N, f M.V.$_x$, i+h — M_x

To find M_y: g JCI.$_y$, h k÷N, i M.V.$_y$, n+m — M_y

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18 324	36 648	54 972	72 1296	90 1620	108 1944																																		
17 289	34 578	51 867	68 1156	85 1445	102 1734																																		
16 256	32 512	48 768	64 1024	80 1280	96 1536	112 1792																																	
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13 169	26 338	39 507	52 676	65 845	78 1014	91 1183	104 1352	117 1521	130 1690	143 1859																													
12 144	24 288	36 432	48 576	60 720	72 864	84 1008	96 1152	108 1296	120 1440	132 1584	144 1728	156 1872																											
11 121	22 242	33 363	44 484	55 605	66 726	77 847	88 968	99 1089	110 1210	121 1331	132 1452	143 1573	154 1694	165 1815	176 1936																								
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4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160	44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320	84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480	124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
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2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40	22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80	42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120	62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90	33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180	63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270	93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160	44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320	84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480	124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250	55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500	105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750	155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360	66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720	126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080	186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490	77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980	147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470	217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640	88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280	168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920	248 1984	256 2048	264 2112	272 2176	280 2240	288 2304	296 2368	304 2432	312 2496	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	[illegible]
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	[illegible]
69	4761	139	[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

46

Correlation between Teachers' Geometry Marks (x) and Lee 1 test Scores (y) r_{xy} = .63 ± .04

CLASS INTERVAL Y-VARIABLE	0-9	10-19	20-29	30-39	40-49	50-59	60-69
FY	8	16	25	19	11	4	5
Y	2	1	0	1	2	3	4
YFY	16	16	73 (D)	19	22	12	20
Y^2	4	1	0	1	4	9	16
Y^2FY	32	16	0	19	44	36	80

CLASS INTERVAL X-VARIABLE	FX	X	XFX	X^2	X^2FX
10-19	1	4	4	16	16
20-29	3	3	9	9	27
30-39	7	2	14	4	28
40-49	7	1	7	1	7
50-59	18	0	87 (A)	0	0
60-69	28	1	28	1	28
70-79	14	2	28	4	56
80-89	9	3	27	9	81
90-99	1	4	4	16	16

N 88   B 34   C 259

FV	V^2	V^2FV
4	9	36
23	4	92
36	1	36
25	0	0
N 88		G 164

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ \div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

N 88   E 32   F 227

To find σ_x: P÷N = 2.58 (a); $\sqrt{a}$ = 1.61 (b); C.I.$_x$ = 10 (c); b×c = 16.1 — σ_x

To find σ_y: Q÷N (d); $\sqrt{d}$ (e); C.I.$_y$ (f); e×f — σ_y

To find M_x: HCI$_x$ (g); g÷N (h); M.V.$_x$ (i); i+h — M_x

To find M_y: JC.I.$_y$ (k); k÷N (m); M.V.$_y$ (n); n+m — M_y

CALCULATION

A	87		H^2	2809
B	34		C	259
A-B	53	H	C-H^2÷N	32 P
D	73			
E	32			
D-E	41	J	J^2	1681
HJ	2173		F	227
HJ÷N	25		J^2÷N	19
2HJ÷N	50	K	F-J^2÷N	208 Q

NUMERATOR

C	259
F	227
C+F	486
G	164
C+F-G	322 L
K	50
L-K	272 M

DENOMINATOR

PQ	47216
$\sqrt{PQ}$	217.29
$2\sqrt{PQ}$	434.58 S

COEF. OF COR.: M÷S = .63 r_{xy}

To find P.E.$_r$

r^2	.3969	
1-r^2	.6031	T
$\sqrt{N}$	9.38	W
T÷W	.0643	Z
.67Z	.04	P.E.$_r$

Table of Products

40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
																																		108 1944	90 1620	72 1296	54 972	36 648	18 324
																																		102 1734	85 1445	68 1156	51 867	34 578	17 289
																																	112 1792	96 1536	80 1280	64 1024	48 768	32 512	16 256
																																120 1800	105 1575	90 1350	75 1125	60 900	45 675	30 450	15 225
																														140 1960	126 1764	112 1568	98 1372	84 1176	70 980	56 784	42 588	28 392	14 196
																													143 1859	130 1690	117 1521	104 1352	91 1183	78 1014	65 845	52 676	39 507	26 338	13 169
																											156 1872	144 1728	132 1584	120 1440	108 1296	96 1152	84 1008	72 864	60 720	48 576	36 432	24 288	12 144
																								176 1936	165 1815	154 1694	143 1573	132 1452	121 1331	110 1210	99 1089	88 968	77 847	66 726	55 605	44 484	33 363	22 242	11 121
																					190 1900	180 1800	170 1700	160 1600	150 1500	140 1400	130 1300	120 1200	110 1100	100 1000	90 900	80 800	70 700	60 600	50 500	40 400	30 300	20 200	10 100
																216 1944	207 1863	198 1782	189 1701	180 1620	171 1539	162 1458	153 1377	144 1296	135 1215	126 1134	117 1053	108 972	99 891	90 810	81 729	72 648	63 567	54 486	45 405	36 324	27 243	18 162	9 81
									248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
40	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
320 2560	312 2496	304 2432	296 2368	288 2304	280 2240	272 2176	264 2112	256 2048	248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	190[illegible]
69	4761	139	19[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

Correlation between Teachers' Geometry Marks (x) and combined scores on Tests 1, 3, and 4 on Lee Test (y) r_{xy} = .56 ± .05

Scatter diagram (X-variable class interval by Y-variable class interval):

X class interval	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39
10-19		1						
20-29		2	1					
30-39	3	2		1	1			
40-49	1	4			2			
50-59	2	3	6	4	2	1		
60-69	3	5	5	8	5	1		1
70-79 (center)		1	2	2	2	4	1	2
80-89			1	2	1	1	2	2
90-99								1

X-variable columns:

Class interval	X	FX	XFX	X^2	X^2FX
10-19	5	1	5	25	25
20-29	4	3	12	16	48
30-39	3	7	21	9	63
40-49	2	7	14	4	28
50-59	1	18	18	1	18
60-69	0	28	35 (A)	0	0
70-79	1	14	14	1	14
80-89	2	9	18	4	36
90-99	3	1	3	9	9
Totals		N 88	B 70		C 241

Y-variable rows:

Class interval	Y	FY	YFY	Y^2	Y^2FY
35-39	4	6	24	16	96
30-34	3	3	9	9	27
25-29	2	7	14	4	28
20-24 (center)	1	13	13	1	13
15-19	0	17	60 (D)	0	0
10-14	1	15	15	1	15
5-9	2	18	36	4	72
0-4	3	9	27	9	81
Totals		N 88	E 78		F 332

Diagonal columns:

	FV	V^2	V^2FV
A	24	0	0
B	30	1	30
C	19	4	76
D	13	9	117
E	2	16	32
Totals	N 88		G 255

Correlation Formula

$$r_{xy}=\frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION

A	35
B	70
A-B = H	35
D	60
E	78
D-E = J	18
H	35
HJ	630
HJ÷N	7
2HJ÷N = K	14
C	241
F	332
C+F	573
G	255
C+F-G = L	318
K	14
L-K = M (NUMERATOR)	304

H^2	1225
C	241
$H^2\div N$	14
$C-H^2\div N$ = P	227
J^2	324
F	332
$J^2\div N$	4
$F-J^2\div N$ = Q	328
PQ	74456
$\sqrt{PQ}$	272.87
$2\sqrt{PQ}$ = S (DENOMINATOR)	545.74
M÷S = r_{xy} (COEF. OF COR.)	.56

To find P.E.$_r$

r^2	.3136
$1-r^2$ = T	.6864
$\sqrt{N}$ = W	9.38
T÷W = Z	.0732
.67Z = P.E.$_r$	.05

To find σ_x: P÷N = a; $\sqrt{a}$ = b; C.I.$_x$ = c; b×c = σ_x

To find σ_y: Q÷N = d; $\sqrt{d}$ = e; C.I.$_y$ = f; e×f = σ_y

To find M_x: H C.I.$_x$ = g; g÷N = h; M.V.$_x$ = i; i+h = M_x

To find M_y: J C.I.$_y$ = k; k÷N = m; M.V.$_y$ = n; n+m = M_y

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Table of Products

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	18 324	36 648	54 972	72 1296	90 1620	108 1944																																		
	17 289	34 578	51 867	68 1156	85 1445	102 1734																																		
	16 256	32 512	48 768	64 1024	80 1280	96 1536	112 1792																																	
	15 225	30 450	45 675	60 900	75 1125	90 1350	105 1575	120 1800																																
	14 196	28 392	42 588	56 784	70 980	84 1176	98 1372	112 1568	126 1764	140 1960																														
	13 169	26 338	39 507	52 676	65 845	78 1014	91 1183	104 1352	117 1521	130 1690	143 1859																													
	12 144	24 288	36 432	48 576	60 720	72 864	84 1008	96 1152	108 1296	120 1440	132 1584	144 1728	156 1872																											
	11 121	22 242	33 363	44 484	55 605	66 726	77 847	88 968	99 1089	110 1210	121 1331	132 1452	143 1573	154 1694	165 1815	176 1936																								
	10 100	20 200	30 300	40 400	50 500	60 600	70 700	80 800	90 900	100 1000	110 1100	120 1200	130 1300	140 1400	150 1500	160 1600	170 1700	180 1800	190 1900																					
	9 81	18 162	27 243	36 324	45 405	54 486	63 567	72 648	81 729	90 810	99 891	108 972	117 1053	126 1134	135 1215	144 1296	153 1377	162 1458	171 1539	180 1620	189 1701	198 1782	207 1863	216 1944																
	8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640	88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280	168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920	248 1984									
	7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490	77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980	147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470	217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
	6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360	66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720	126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080	186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
	5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250	55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500	105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750	155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
	4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160	44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320	84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480	124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
	3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90	33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180	63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270	93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
	2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40	22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80	42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120	62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
	1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20	21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30	31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20	21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30	31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
	2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40	22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80	42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120	62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
	3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90	33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180	63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270	93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
	4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160	44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320	84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480	124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
	5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250	55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500	105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750	155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
	6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360	66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720	126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080	186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
	7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490	77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980	147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470	217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
	8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640	88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280	168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920	248 1984	256 2048	264 2112	272 2176	280 2240	288 2304	296 2368	304 2432	312 2496	320 2560

Table of Squares

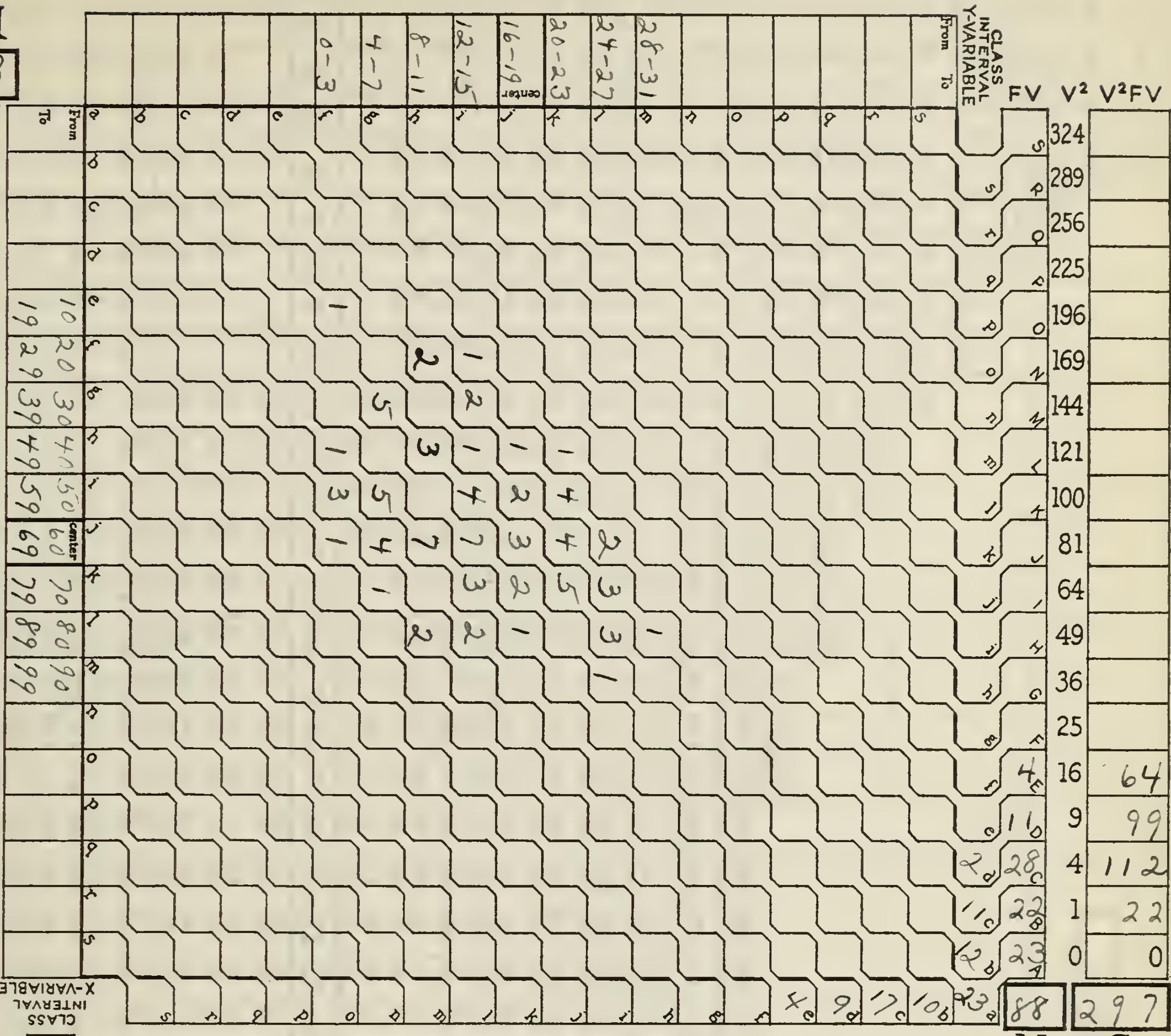
Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	79[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	190[illegible]
69	4761	139	193[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

48

Correlation between Teachers' Geometry Marks (x) and Scores on Test 2 on Lee Test (y) r_{xy} = .48 ± .05



N 88 | B 34 | C 259 | A 87 | E 62 | D 68 | F 290 | G 297

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION			
A	87	H^2	2809
B	34	C	259
A-B	53 H	$H^2\div N$	32
D	68	$C-H^2\div N$	227 P
E	62	J^2	36
D-E	6 J	F	290
H	53	$J^2\div N$	.4
HJ	318	$F-J^2\div N$	289.6 Q
HJ÷N	3.6		
2HJ÷N	7.2 K		

NUMERATOR		DENOMINATOR	
C	259	PQ	65739
F	290	$\sqrt{PQ}$	256.4
C+F	549	$2\sqrt{PQ}$	512.8 S
G	297		
C+F-G	252 L		
K	7		
L-K	245 M	M÷S (COEF. OF COR.)	.48 r_{xy}

To find P.E.r

r^2	.2304
$1-r^2$	.7696 T
$\sqrt{N}$	9.38 W
T÷W	.082 Z
.6745 Z	.05 P.E.r

To find σ_x: P÷N a; $\sqrt{a}$ b; C.I.$_x$ c; b×c σ_x

To find σ_y: Q÷N d; $\sqrt{d}$ e; C.I.$_y$ f; e×f σ_y

To find M_x: HCI.$_x$ d; g÷N e; M.V.$_x$ f; i+h M_x

To find M_y: JC.I.$_y$ g; k÷N h; M.V.$_y$ i; n+m M_y

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Table of Products

1	18 324	17 289	16 256	15 225	14 196	13 169	12 144	11 121	10 100	9 81	8 64	7 49	6 36	5 25	4 16	3 9	2 4	1 1
2	36 648	34 578	32 512	30 450	28 392	26 338	24 288	22 242	20 200	18 162	16 128	14 98	12 72	10 50	8 32	6 18	4 8	2 2
3	54 972	51 867	48 768	45 675	42 588	39 507	36 432	33 363	30 300	27 243	24 192	21 147	18 108	15 75	12 48	9 27	6 12	3 3
4	72 1296	68 1156	64 1024	60 900	56 784	52 676	48 576	44 484	40 400	36 324	32 256	28 196	24 144	20 100	16 64	12 36	8 16	4 4
5	90 1620	85 1445	80 1280	75 1125	70 980	65 845	60 720	55 605	50 500	45 405	40 320	35 245	30 180	25 125	20 80	15 45	10 20	5 5
6	108 1944	102 1734	96 1536	90 1350	84 1176	78 1014	72 864	66 726	60 600	54 486	48 384	42 294	36 216	30 150	24 96	18 54	12 24	6 6
7			112 1792	105 1575	98 1372	91 1183	84 1008	77 847	70 700	63 567	56 448	49 343	42 252	35 175	28 112	21 63	14 28	7 7
8				120 1800	112 1568	104 1352	96 1152	88 968	80 800	72 648	64 512	56 392	48 288	40 200	32 128	24 72	16 32	8 8
9					126 1764	117 1521	108 1296	99 1089	90 900	81 729	72 576	63 441	54 324	45 225	36 144	27 81	18 36	9 9
10					140 1960	130 1690	120 1440	110 1210	100 1000	90 810	80 640	70 490	60 360	50 250	40 160	30 90	20 40	10 10
11						143 1859	132 1584	121 1331	110 1100	99 891	88 704	77 539	66 396	55 275	44 176	33 99	22 44	11 11
12							144 1728	132 1452	120 1200	108 972	96 768	84 588	72 432	60 300	48 192	36 108	24 48	12 12
13							156 1872	143 1573	130 1300	117 1053	104 832	91 637	78 468	65 325	52 208	39 117	26 52	13 13
14								154 1694	140 1400	126 1134	112 896	98 686	84 504	70 350	56 224	42 126	28 56	14 14
15								165 1815	150 1500	135 1215	120 960	105 735	90 540	75 375	60 240	45 135	30 60	15 15
16								176 1936	160 1600	144 1296	128 1024	112 784	96 576	80 400	64 256	48 144	32 64	16 16
17									170 1700	153 1377	136 1088	119 833	102 612	85 425	68 272	51 153	34 68	17 17
18									180 1800	162 1458	144 1152	126 882	108 648	90 450	72 288	54 162	36 72	18 18
19									190 1900	171 1539	152 1216	133 931	114 684	95 475	76 304	57 171	38 76	19 19
20										180 1620	160 1280	140 980	120 720	100 500	80 320	60 180	40 80	20 20
21										189 1701	168 1344	147 1029	126 756	105 525	84 336	63 189	42 84	21 21
22										198 1782	176 1408	154 1078	132 792	110 550	88 352	66 198	44 88	22 22
23										207 1863	184 1472	161 1127	138 828	115 575	92 368	69 207	46 92	23 23
24										216 1944	192 1536	168 1176	144 864	120 600	96 384	72 216	48 96	24 24
25											200 1600	175 1225	150 900	125 625	100 400	75 225	50 100	25 25
26											208 1664	182 1274	156 936	130 650	104 416	78 234	52 104	26 26
27											216 1728	189 1323	162 972	135 675	108 432	81 243	54 108	27 27
28											224 1792	196 1372	168 1008	140 700	112 448	84 252	56 112	28 28
29											232 1856	203 1421	174 1044	145 725	116 464	87 261	58 116	29 29
30											240 1920	210 1470	180 1080	150 750	120 480	90 270	60 120	30 30
31											248 1984	217 1519	186 1116	155 775	124 496	93 279	62 124	31 31
32												224 1568	192 1152	160 800	128 512	96 288	64 128	32 32
33												231 1617	198 1188	165 825	132 528	99 297	66 132	33 33
34												238 1666	204 1224	170 850	136 544	102 306	68 136	34 34
35												245 1715	210 1260	175 875	140 560	105 315	70 140	35 35
36												252 1764	216 1296	180 900	144 576	108 324	72 144	36 36
37												259 1813	222 1332	185 925	148 592	111 333	74 148	37 37
38												263 1862	223 1368	190 950	152 603	114 342	76 152	38 38
39												273 1911	234 1404	195 975	156 624	117 351	78 156	39 39
40												280 1960	240 1440	200 1000	160 640	120 360	80 160	40 40

1	1 1	2 4	3 9	4 16	5 25	6 36	7 49	8 64
2	2 2	4 8	6 18	8 32	10 50	12 72	14 98	16 128
3	3 3	6 12	9 27	12 48	15 75	18 108	21 147	24 192
4	4 4	8 16	12 36	16 64	20 100	24 144	28 196	32 256
5	5 5	10 20	15 45	20 80	25 125	30 180	35 245	40 320
6	6 6	12 24	18 54	24 96	30 150	36 216	42 294	48 384
7	7 7	14 28	21 63	28 112	35 175	42 252	49 343	56 448
8	8 8	16 32	24 72	32 128	40 200	48 288	56 392	64 512
9	9 9	18 36	27 81	36 144	45 225	54 324	63 441	72 576
10	10 10	20 40	30 90	40 160	50 250	60 360	70 490	80 640
11	11 11	22 44	33 99	44 176	55 275	66 396	77 539	88 704
12	12 12	24 48	36 108	48 192	60 300	72 432	84 588	96 768
13	13 13	26 52	39 117	52 208	65 325	78 468	91 637	104 832
14	14 14	28 56	42 126	56 224	70 350	84 504	98 686	112 896
15	15 15	30 60	45 135	60 240	75 375	90 540	105 735	120 960
16	16 16	32 64	48 144	64 256	80 400	96 576	112 784	128 1024
17	17 17	34 68	51 153	68 272	85 425	102 612	119 833	136 1088
18	18 18	36 72	54 162	72 288	90 450	108 648	126 882	144 1152
19	19 19	38 76	57 171	76 304	95 475	114 684	133 931	152 1216
20	20 20	40 80	60 180	80 320	100 500	120 720	140 980	160 1280
21	21 21	42 84	63 189	84 336	105 525	126 756	147 1029	168 1344
22	22 22	44 88	66 198	88 352	110 550	132 792	154 1078	176 1408
23	23 23	46 92	69 207	92 368	115 575	138 828	161 1127	184 1472
24	24 24	48 96	72 216	96 384	120 600	144 864	168 1176	192 1536
25	25 25	50 100	75 225	100 400	125 625	150 900	175 1225	200 1600
26	26 26	52 104	78 234	104 416	130 650	156 936	182 1274	208 1664
27	27 27	54 108	81 243	108 432	135 675	162 972	189 1323	216 1728
28	28 28	56 112	84 252	112 448	140 700	168 1008	196 1372	224 1792
29	29 29	58 116	87 261	116 464	145 725	174 1044	203 1421	232 1856
30	30 30	60 120	90 270	120 480	150 750	180 1080	210 1470	240 1920
31	31 31	62 124	93 279	124 496	155 775	186 1116	217 1519	248 1984
32	32 32	64 128	96 288	128 512	160 800	192 1152	224 1568	256 2048
33	33 33	66 132	99 297	132 528	165 825	198 1188	231 1617	264 2112
34	34 34	68 136	102 306	136 544	170 850	204 1224	238 1666	272 2176
35	35 35	70 140	105 315	140 560	175 875	210 1260	245 1715	280 2240
36	36 36	72 144	108 324	144 576	180 900	216 1296	252 1764	288 2304
37	37 37	74 148	111 333	148 592	185 925	222 1332	259 1813	296 2368
38	38 38	76 152	114 342	152 608	190 950	228 1368	266 1862	304 2432
39	39 39	78 156	117 351	156 624	195 975	234 1404	273 1911	312 2496
40	40 40	80 160	120 360	160 640	200 1000	240 1440	280 1960	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	190[illegible]
69	4761	139	19[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

Correlation between Achievement Test Scores (x) and Ed. Test Scores (y) r_{xy} = .69 ± .04

N 65 B 41 C 362

Class interval Y-variable: 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69

Class interval X-variable: 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99

N 65 G 176

N 65 E 23 F 176

D 55

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION

A	81	H^2	1600
B	41	C	362
A-B	40 H	$H^2\div N$	24.6
D	55	$C-H^2\div N$	337.4 P
E	23	J^2	1024
D-E	32 J	F	176
H	40	$J^2\div N$	15.8
HJ	1280	$F-J^2\div N$	160.2 Q
HJ÷N	19.7		
2HJ÷N	39.4 K		

NUMERATOR / DENOMINATOR

C	362	PQ	54051.5
F	176	$\sqrt{PQ}$	232.5
C+F	538	$2\sqrt{PQ}$	465 S
G	176		
C+F-G	362 L		
K	39.4		
L-K	322.6 M	M÷S	.69 r_{xy} (COEF. OF COR.)

To find P.E.$_r$

r^2	.4761
$1-r^2$	.5239 T
$\sqrt{N}$	8.06 W
T÷W	.065 Z
.6745Z	.04 P.E.$_r$

To find σ_x: a P÷N; b $\sqrt{a}$; c C.I.$_x$; b×c; σ_x

To find σ_y: Q÷N; $\sqrt{d}$; C.I.$_y$; e×f; σ_y

To find M_x: d H C.I.$_x$; e g÷N; f M.V.$_x$; i+h; M_x

To find M_y: g J C.I.$_y$; h k÷N; i M.V.$_y$; n+m; M_y

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Table of Products

1	18 324	17 289	16 256	15 225	14 196	13 169	12 144	11 121	10 100	9 81	8 64	7 49	6 36	5 25	4 16	3 9	2 4	1 1	1	1 1	2 4	3 9	4 16	5 25	6 36	7 49	8 64
2	36 648	34 578	32 512	30 450	28 392	26 338	24 288	22 242	20 200	18 162	16 128	14 98	12 72	10 50	8 32	6 18	4 8	2 2	2	2 2	4 8	6 18	8 32	10 50	12 72	14 98	16 128
3	54 972	51 867	48 768	45 675	42 588	39 507	36 432	33 363	30 300	27 243	24 192	21 147	18 108	15 75	12 48	9 27	6 12	3 3	3	3 3	6 12	9 27	12 48	15 75	18 108	21 147	24 192
4	72 1296	68 1156	64 1024	60 900	56 784	52 676	48 576	44 484	40 400	36 324	32 256	28 196	24 144	20 100	16 64	12 36	8 16	4 4	4	4 4	8 16	12 36	16 64	20 100	24 144	28 196	32 256
5	90 1620	85 1445	80 1280	75 1125	70 980	65 845	60 720	55 605	50 500	45 405	40 320	35 245	30 180	25 125	20 80	15 45	10 20	5 5	5	5 5	10 20	15 45	20 80	25 125	30 180	35 245	40 320
6	108 1944	102 1734	96 1536	90 1350	84 1176	78 1014	72 864	66 726	60 600	54 486	48 384	42 294	36 216	30 150	24 96	18 54	12 24	6 6	6	6 6	12 24	18 54	24 96	30 150	36 216	42 294	48 384
7			112 1792	105 1575	98 1372	91 1183	84 1008	77 847	70 700	63 567	56 448	49 343	42 252	35 175	28 112	21 63	14 28	7 7	7	7 7	14 28	21 63	28 112	35 175	42 252	49 343	56 448
8				120 1800	112 1568	104 1352	96 1152	88 968	80 800	72 648	64 512	56 392	48 288	40 200	32 128	24 72	16 32	8 8	8	8 8	16 32	24 72	32 128	40 200	48 288	56 392	64 512
9					126 1764	117 1521	108 1296	99 1089	90 900	81 729	72 576	63 441	54 324	45 225	36 144	27 81	18 36	9 9	9	9 9	18 36	27 81	36 144	45 225	54 324	63 441	72 576
10					140 1960	130 1690	120 1440	110 1210	100 1000	90 810	80 640	70 490	60 360	50 250	40 160	30 90	20 40	10 10	10	10 10	20 40	30 90	40 160	50 250	60 360	70 490	80 640
11						143 1859	132 1584	121 1331	110 1100	99 891	88 704	77 539	66 396	55 275	44 176	33 99	22 44	11 11	11	11 11	22 44	33 99	44 176	55 275	66 396	77 539	88 704
12							144 1728	132 1452	120 1200	108 972	96 768	84 588	72 432	60 300	48 192	36 108	24 48	12 12	12	12 12	24 48	36 108	48 192	60 300	72 432	84 588	96 768
13							156 1872	143 1573	130 1300	117 1053	104 832	91 637	78 468	65 325	52 208	39 117	26 52	13 13	13	13 13	26 52	39 117	52 208	65 325	78 468	91 637	104 832
14								154 1694	140 1400	126 1134	112 896	98 686	84 504	70 350	56 224	42 126	28 56	14 14	14	14 14	28 56	42 126	56 224	70 350	84 504	98 686	112 896
15								165 1815	150 1500	135 1215	120 960	105 735	90 540	75 375	60 240	45 135	30 60	15 15	15	15 15	30 60	45 135	60 240	75 375	90 540	105 735	120 960
16								176 1936	160 1600	144 1296	128 1024	112 784	96 576	80 400	64 256	48 144	32 64	16 16	16	16 16	32 64	48 144	64 256	80 400	96 576	112 784	128 1024
17									170 1700	153 1377	136 1088	119 833	102 612	85 425	68 272	51 153	34 68	17 17	17	17 17	34 68	51 153	68 272	85 425	102 612	119 833	136 1088
18									180 1800	162 1458	144 1152	126 882	108 648	90 450	72 288	54 162	36 72	18 18	18	18 18	36 72	54 162	72 288	90 450	108 648	126 882	144 1152
19									190 1900	171 1539	152 1216	133 931	114 684	95 475	76 304	57 171	38 76	19 19	19	19 19	38 76	57 171	76 304	95 475	114 684	133 931	152 1216
20										180 1620	160 1280	140 980	120 720	100 500	80 320	60 180	40 80	20 20	20	20 20	40 80	60 180	80 320	100 500	120 720	140 980	160 1280
21										189 1701	168 1344	147 1029	126 756	105 525	84 336	63 189	42 84	21 21	21	21 21	42 84	63 189	84 336	105 525	126 756	147 1029	168 1344
22										198 1782	176 1408	154 1078	132 792	110 550	88 352	66 198	44 88	22 22	22	22 22	44 88	66 198	88 352	110 550	132 792	154 1078	176 1408
23										207 1863	184 1472	161 1127	138 828	115 575	92 368	69 207	46 92	23 23	23	23 23	46 92	69 207	92 368	115 575	138 828	161 1127	184 1472
24										216 1944	192 1536	168 1176	144 864	120 600	96 384	72 216	48 96	24 24	24	24 24	48 96	72 216	96 384	120 600	144 864	168 1176	192 1536
25											200 1600	175 1225	150 900	125 625	100 400	75 225	50 100	25 25	25	25 25	50 100	75 225	100 400	125 625	150 900	175 1225	200 1600
26											208 1664	182 1274	156 936	130 650	104 416	78 234	52 104	26 26	26	26 26	52 104	78 234	104 416	130 650	156 936	182 1274	208 1664
27											216 1728	189 1323	162 972	135 675	108 432	81 243	54 108	27 27	27	27 27	54 108	81 243	108 432	135 675	162 972	189 1323	216 1728
28											224 1792	196 1372	168 1008	140 700	112 448	84 252	56 112	28 28	28	28 28	56 112	84 252	112 448	140 700	168 1008	196 1372	224 1792
29											232 1856	203 1421	174 1044	145 725	116 464	87 261	58 116	29 29	29	29 29	58 116	87 261	116 464	145 725	174 1044	203 1421	232 1856
30											240 1920	210 1470	180 1080	150 750	120 480	90 270	60 120	30 30	30	30 30	60 120	90 270	120 480	150 750	180 1080	210 1470	240 1920
31											248 1984	217 1519	186 1116	155 775	124 496	93 279	62 124	31 31	31	31 31	62 124	93 279	124 496	155 775	186 1116	217 1519	248 1984
32												224 1568	192 1152	160 800	128 512	96 288	64 128	32 32	32	32 32	64 128	96 288	128 512	160 800	192 1152	224 1568	256 2048
33												231 1617	198 1188	165 825	132 528	99 297	66 132	33 33	33	33 33	66 132	99 297	132 528	165 825	198 1188	231 1617	264 2112
34												238 1666	204 1224	170 850	136 544	102 306	68 136	34 34	34	34 34	68 136	102 306	136 544	170 850	204 1224	238 1666	272 2176
35												245 1715	210 1260	175 875	140 560	105 315	70 140	35 35	35	35 35	70 140	105 315	140 560	175 875	210 1260	245 1715	280 2240
36												252 1764	216 1296	180 900	144 576	108 324	72 144	36 36	36	36 36	72 144	108 324	144 576	180 900	216 1296	252 1764	288 2304
37												259 1813	222 1332	185 925	148 592	111 333	74 148	37 37	37	37 37	74 148	111 333	148 592	185 925	222 1332	259 1813	296 2368
38												266 1862	228 1368	190 950	152 608	114 342	76 152	38 38	38	38 38	76 152	114 342	152 608	190 950	228 1368	266 1862	304 2432
39												273 1911	234 1404	195 975	156 624	117 351	78 156	39 39	39	39 39	78 156	117 351	156 624	195 975	234 1404	273 1911	312 2496
40												280 1960	240 1440	200 1000	160 640	120 360	80 160	40 40	40	40 40	80 160	120 360	160 640	200 1000	240 1440	280 1960	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	79[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	190[illegible]
69	4761	139	193[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

Correlation between Teacher's Geometry marks (x) and Numbers 1 set scores (y) r_{xy} = .32 ± .07

CLASS INTERVAL X-VARIABLE (From–To)		FX	X	XFX	X^2	X^2FX	20–24 (e)	25–29 (f)	30–34 (g)	35–39 (h)	40–44 (i)	45–49 (j, Center)	50–54 (k)	55–59 (l)	60–64 (m)
a			8		64										
b			7		49										
c			6		36										
d			5		25										
e	20–29	2	4	8	16	32	1			1					
f	30–39	5	3	15	9	45				2	1	2			
g	40–49	6	2	12	4	24	1	2		2	1				
h	50–59	15	1	15	1	15		2	2	4	3	2	1	1	
i	60–69	26	0	A 44		0	3		3	6	7	4	3		
j (Center 70)	70–79	11	1	11	1	11			1	3	1	4	1	1	
k	80–89	12	2	24	4	48		1	1	3	3	1		2	1
l	90–99	3	3	9	9	27						1	2		
m			4		16										
n			5		25										
o			6		36										
p			7		49										
q			8		64										
r			9		81										
s			10		100										
Totals		N 80		B 50		C 202									

Y	FY	YFY	Y^2	Y^2FY
8			64	
7			49	
6			36	
5			25	
4	5	20	16	80
3	5	15	9	45
2	7	14	4	28
1	21	21	1	21
0	16	D 44		0
1	14	14	1	14
2	7	14	4	28
3	4	12	9	36
4	1	4	16	16
5			25	
6			36	
7			49	
8			64	
9			81	
10			100	
Totals	N 80	E 70		F 268

V	FV	V^2	V^2FV
S		324	
R		289	
Q		256	
P		225	
O		196	
N		169	
M		144	
L		121	
K		100	
J		81	
I		64	
H		49	
G		36	
F	1	25	25
E	7	16	112
D	7	9	63
C	23	4	92
B	26	1	26
A	16	0	0
Totals	N 80		G 318

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION

A	44		H^2	36	
B	50		C	202	
A-B-	6	H	$H^2\div N$	.5	
D	44		$C-H^2\div N$	201.5	P
E	70				
D-E-	26	J	J^2	676	
H	6		F	268	
HJ	156		$J^2\div N$	8.5	
HJ÷N	2				
2HJ÷N	4	K	$F-J^2\div N$	259.5	Q

NUMERATOR / DENOMINATOR

C	202		PQ	52289	
F	268		$\sqrt{PQ}$	228.7	
C+F	470		$2\sqrt{PQ}$	457.4	S
G	318				
C+F-G	152	L			
K	4				
L-K	148	M	M÷S	.32	r_{xy} (COEF. OF COR.)

To find PE_r

r^2	.1024	
$1-r^2$	.8976	T
$\sqrt{N}$	8.94	W
T÷W	.1	Z
.67Z	.067	$P.E._r$

To find σ_x

P÷N		a
$\sqrt{a}$		b
$C.I._x$		c
b×c		σ_x

To find σ_y

Q÷N		d
$\sqrt{d}$		e
$C.I._y$		f
e×f		σ_y

To find M_x

d	$HC.I._x$	g
e	g÷N	h
f	$M.V._x$	i
	i+h	M_x

To find M_y

g	$JC.I._y$	k
h	k÷N	m
i	$M.V._y$	n
	n+m	M_y

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Table of Products

1	18 324	17 289	16 256	15 225	14 196	13 169	12 144	11 121	10 100	9 81	8 64	7 49	6 36	5 25	4 16	3 9	2 4	1 1	**1**	1 1	2 4	3 9	4 16	5 25	6 36	7 49	8 64
2	36 648	34 578	32 512	30 450	28 392	26 338	24 288	22 242	20 200	18 162	16 128	14 98	12 72	10 50	8 32	6 18	4 8	2 2	**2**	2 2	4 8	6 18	8 32	10 50	12 72	14 98	16 128
3	54 972	51 867	48 768	45 675	42 588	39 507	36 432	33 363	30 300	27 243	24 192	21 147	18 108	15 75	12 48	9 27	6 12	3 3	**3**	3 3	6 12	9 27	12 48	15 75	18 108	21 147	24 192
4	72 1296	68 1156	64 1024	60 900	56 784	52 676	48 576	44 484	40 400	36 324	32 256	28 196	24 144	20 100	16 64	12 36	8 16	4 4	**4**	4 4	8 16	12 36	16 64	20 100	24 144	28 196	32 256
5	90 1620	85 1445	80 1280	75 1125	70 980	65 845	60 720	55 605	50 500	45 405	40 320	35 245	30 180	25 125	20 80	15 45	10 20	5 5	**5**	5 5	10 20	15 45	20 80	25 125	30 180	35 245	40 320
6	108 1944	102 1734	96 1536	90 1350	84 1176	78 1014	72 864	66 726	60 600	54 486	48 384	42 294	36 216	30 150	24 96	18 54	12 24	6 6	**6**	6 6	12 24	18 54	24 96	30 150	36 216	42 294	48 384
7			112 1792	105 1575	98 1372	91 1183	84 1008	77 847	70 700	63 567	56 448	49 343	42 252	35 175	28 112	21 63	14 28	7 7	**7**	7 7	14 28	21 63	28 112	35 175	42 252	49 343	56 448
8				120 1800	112 1568	104 1352	96 1152	88 968	80 800	72 648	64 512	56 392	48 288	40 200	32 128	24 72	16 32	8 8	**8**	8 8	16 32	24 72	32 128	40 200	48 288	56 392	64 512
9					126 1764	117 1521	108 1296	99 1089	90 900	81 729	72 576	63 441	54 324	45 225	36 144	27 81	18 36	9 9	**9**	9 9	18 36	27 81	36 144	45 225	54 324	63 441	72 576
10					140 1960	130 1690	120 1440	110 1210	100 1000	90 810	80 640	70 490	60 360	50 250	40 160	30 90	20 40	10 10	**10**	10 10	20 40	30 90	40 160	50 250	60 360	70 490	80 640
11						143 1859	132 1584	121 1331	110 1100	99 891	88 704	77 539	66 396	55 275	44 176	33 99	22 44	11 11	**11**	11 11	22 44	33 99	44 176	55 275	66 396	77 539	88 704
12							144 1728	132 1452	120 1200	108 972	96 768	84 588	72 432	60 300	48 192	36 108	24 48	12 12	**12**	12 12	24 48	36 108	48 192	60 300	72 432	84 588	96 768
13							156 1872	143 1573	130 1300	117 1053	104 832	91 637	78 468	65 325	52 208	39 117	26 52	13 13	**13**	13 13	26 52	39 117	52 208	65 325	78 468	91 637	104 832
14								154 1694	140 1400	126 1134	112 896	98 686	84 504	70 350	56 224	42 126	28 56	14 14	**14**	14 14	28 56	42 126	56 224	70 350	84 504	98 686	112 896
15								165 1815	150 1500	135 1215	120 960	105 735	90 540	75 375	60 240	45 135	30 60	15 15	**15**	15 15	30 60	45 135	60 240	75 375	90 540	105 735	120 960
16								176 1936	160 1600	144 1296	128 1024	112 784	96 576	80 400	64 256	48 144	32 64	16 16	**16**	16 16	32 64	48 144	64 256	80 400	96 576	112 784	128 1024
17									170 1700	153 1377	136 1088	119 833	102 612	85 425	68 272	51 153	34 68	17 17	**17**	17 17	34 68	51 153	68 272	85 425	102 612	119 833	136 1088
18									180 1800	162 1458	144 1152	126 882	108 648	90 450	72 288	54 162	36 72	18 18	**18**	18 18	36 72	54 162	72 288	90 450	108 648	126 882	144 1152
19									190 1900	171 1539	152 1216	133 931	114 684	95 475	76 304	57 171	38 76	19 19	**19**	19 19	38 76	57 171	76 304	95 475	114 684	133 931	152 1216
20										180 1620	160 1280	140 980	120 720	100 500	80 320	60 180	40 80	20 20	**20**	20 20	40 80	60 180	80 320	100 500	120 720	140 980	160 1280
21										189 1701	168 1344	147 1029	126 756	105 525	84 336	63 189	42 84	21 21	**21**	21 21	42 84	63 189	84 336	105 525	126 756	147 1029	168 1344
22										198 1782	176 1408	154 1078	132 792	110 550	88 352	66 198	44 88	22 22	**22**	22 22	44 88	66 198	88 352	110 550	132 792	154 1078	176 1408
23										207 1863	184 1472	161 1127	138 828	115 575	92 368	69 207	46 92	23 23	**23**	23 23	46 92	69 207	92 368	115 575	138 828	161 1127	184 1472
24										216 1944	192 1536	168 1176	144 864	120 600	96 384	72 216	48 96	24 24	**24**	24 24	48 96	72 216	96 384	120 600	144 864	168 1176	192 1536
25											200 1600	175 1225	150 900	125 625	100 400	75 225	50 100	25 25	**25**	25 25	50 100	75 225	100 400	125 625	150 900	175 1225	200 1600
26											208 1664	182 1274	156 936	130 650	104 416	78 234	52 104	26 26	**26**	26 26	52 104	78 234	104 416	130 650	156 936	182 1274	208 1664
27											216 1728	189 1323	162 972	135 675	108 432	81 243	54 108	27 27	**27**	27 27	54 108	81 243	108 432	135 675	162 972	189 1323	216 1728
28											224 1792	196 1372	168 1008	140 700	112 448	84 252	56 112	28 28	**28**	28 28	56 112	84 252	112 448	140 700	168 1008	196 1372	224 1792
29											232 1856	203 1421	174 1044	145 725	116 464	87 261	58 116	29 29	**29**	29 29	58 116	87 261	116 464	145 725	174 1044	203 1421	232 1856
30											240 1920	210 1470	180 1080	150 750	120 480	90 270	60 120	30 30	**30**	30 30	60 120	90 270	120 480	150 750	180 1080	210 1470	240 1920
31											248 1984	217 1519	186 1116	155 775	124 496	93 279	62 124	31 31	**31**	31 31	62 124	93 279	124 496	155 775	186 1116	217 1519	248 1984
32												224 1568	192 1152	160 800	128 512	96 288	64 128	32 32	**32**	32 32	64 128	96 288	128 512	160 800	192 1152	224 1568	256 2048
33												231 1617	198 1188	165 825	132 528	99 297	66 132	33 33	**33**	33 33	66 132	99 297	132 528	165 825	198 1188	231 1617	264 2112
34												238 1666	204 1224	170 850	136 544	102 306	68 136	34 34	**34**	34 34	68 136	102 306	136 544	170 850	204 1224	238 1666	272 2176
35												245 1715	210 1260	175 875	140 560	105 315	70 140	35 35	**35**	35 35	70 140	105 315	140 560	175 875	210 1260	245 1715	280 2240
36												252 1764	216 1296	180 900	144 576	108 324	72 144	36 36	**36**	36 36	72 144	108 324	144 576	180 900	216 1296	252 1764	288 2304
37												259 1813	222 1332	185 925	148 592	111 333	74 148	37 37	**37**	37 37	74 148	111 333	148 592	185 925	222 1332	259 1813	296 2368
38												266 1862	228 1368	190 950	152 608	114 342	76 152	38 38	**38**	38 38	76 152	114 342	152 608	190 950	228 1368	266 1862	304 2432
39												273 1911	234 1404	195 975	156 624	117 351	78 156	39 39	**39**	39 39	78 156	117 351	156 624	195 975	234 1404	273 1911	312 2496
40												280 1960	240 1440	200 1000	160 640	120 360	80 160	40 40	**40**	40 40	80 160	120 360	160 640	200 1000	240 1440	280 1960	320 2560

Table of Squares

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26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19044
69	4761	139	19321
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By *Arthur S. Otis, Ph.D.*
Author of the Otis Group Intelligence Scale

Correlation between achievement test scores (x) and Minnesota test scores (y) r_{xy} = .36 ± .07

N 76 B 76 C 423

X-variable

Class interval (From–To)	FX	X	XFX	X^2	X^2FX
		8		64	
		7		49	
		6		36	
0–9	2	5	10	25	50
10–19	2	4	8	16	32
20–29	11	3	33	9	99
30–39	7	2	14	4	28
40–49	11	1	11	1	11
50–59 (center)	16	0	A 69		0
60–69	5	1	5	1	5
70–79	7	2	14	4	28
80–89	10	3	30	9	90
90–99	5	4	20	16	80
		5		25	
		6		36	
		7		49	
		8		64	
		9		81	
		10		100	

Y-variable class intervals: 20–24, 25–29, 30–34, 35–39, 40–44, 45–49 (center), 50–54, 55–59, 60–64

	FY	Y	YFY	Y^2	Y^2FY
60–64	1	4	4	16	16
55–59	3	3	9	9	27
50–54	6	2	12	4	24
45–49 (center)	13	1	13	1	13
40–44	16	0	D 38		0
35–39	21	1	21	1	21
30–34	7	2	14	4	28
25–29	5	3	15	9	45
20–24	4	4	16	16	64

N 76 E 66 F 238

FV	V^2	V^2FV
1	36	36
2	25	50
8	16	128
12	9	108
22	4	88
21	1	21
10	0	0
N 76		G 431

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

Calculation

A	69	
B	76	
A-B	-7	H
D	38	
E	66	
D-E	-28	J
H	7	
HJ	196	
HJ÷N	2.5	
2HJ÷N	5	K
C	423	
F	238	
C+F	661	
G	431	
C+F-G	230	L
K	5	
L-K	225	M (Numerator)

H^2	49	
C	423	
$H^2\div N$	.6	
$C-H^2\div N$	422.4	P
J^2	784	
F	238	
$J^2\div N$	10.3	
$F-J^2\div N$	227.7	Q
PQ	96180.5	
$\sqrt{PQ}$	310	
$2\sqrt{PQ}$	620	S (Denominator)
M÷S	.36	r_{xy} (Coef. of Cor.)

To find P.E.r

r^2	.1296	
$1-r^2$	.8704	T
$\sqrt{N}$	8.72	W
T÷W	.1	Z
.67Z	.07	P.E.r

To find σ_x: P÷N a, $\sqrt{a}$ b, $C.I._x$ c, b×c σ_x

To find σ_y: Q÷N d, $\sqrt{d}$ e, $C.I._y$ f, e×f σ_y

To find M_x: HCI_x g, g÷N h, $M.V._x$ i, i+h M_x

To find M_y: $JC.I._y$ k, k÷N m, $M.V._y$ n, n+m M_y

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Table of Products

40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
																																		108 1944	90 1620	72 1296	54 972	36 648	18 324
																																		102 1734	85 1445	68 1156	51 867	34 578	17 289
																																	112 1792	96 1536	80 1280	64 1024	48 768	32 512	16 256
																																120 1800	105 1575	90 1350	75 1125	60 900	45 675	30 450	15 225
																														140 1960	126 1764	112 1568	98 1372	84 1176	70 980	56 784	42 588	28 392	14 196
																													143 1859	130 1690	117 1521	104 1352	91 1183	78 1014	65 845	52 676	39 507	26 338	13 169
																											156 1872	144 1728	132 1584	120 1440	108 1296	96 1152	84 1008	72 864	60 720	48 576	36 432	24 288	12 144
																								176 1936	165 1815	154 1694	143 1573	132 1452	121 1331	110 1210	99 1089	88 968	77 847	66 726	55 605	44 484	33 363	22 242	11 121
																					190 1900	180 1800	170 1700	160 1600	150 1500	140 1400	130 1300	120 1200	110 1100	100 1000	90 900	80 800	70 700	60 600	50 500	40 400	30 300	20 200	10 100
																216 1944	207 1863	198 1782	189 1701	180 1620	171 1539	162 1458	153 1377	144 1296	135 1215	126 1134	117 1053	108 972	99 891	90 810	81 729	72 648	63 567	54 486	45 405	36 324	27 243	18 162	9 81
									248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
40	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
320 2560	312 2496	304 2432	296 2368	288 2304	280 2240	272 2176	264 2112	256 2048	248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	79[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19[illegible]
69	4761	139	19[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

Correlation between Teachers' Geometry marks (x) and Intelligence Quotients (y) r_{xy} = .41 ± .05

Correlation Formula

$$r_{xy}=\frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

Scatter diagram (rows: X-variable class intervals; columns: Y-variable class intervals)

Class interval X (From–To)		70-79 (e)	80-89 (f)	90-99 (g)	100-109 (h)	110-119 (i)	120-129 center (j)	130-139 (k)	140-149 (l)	150-159 (m)	FX	X	XFX	X²	X²FX
20–29	e	1				1					2	4	8	16	32
30–39	f		1	2	1	3					7	3	21	9	63
40–49	g		1	3		3	4				11	2	22	4	44
50–59	h	1	1	3	8	4	3	1	1		22	1	22	1	22
60–69	i			8	6	9	5	2		2	32	0	A 38	0	
70–79 center	j			1	1	3	5	1	1		12	1	12	1	12
80–89	k				1	2	3	3		1	10	2	20	4	40
90–99	l					1			1		2	3	6	9	18
											N 98		B 73		C 231

Y	4	3	2	1	0	1	2	3	4	Totals
FY	2	3	17	17	26	20	7	3	3	N 98
YFY	8	9	34	17	D 55	20	14	9	12	E 68
Y²	16	9	4	1	0	1	4	9	16	
Y²FY	32	27	68	17	0	20	28	27	48	F 267

FV	V²	V²FV
4	16	64
12	9	108
23	4	92
28	1	28
31	0	0
N 98		G 292

31a 16b 12c 4d

12b 11c 8d 4e

Calculation

A	38	H²	1225
B	73	C	231
A-B	–35 H	H²÷N	12.5
D	55	C-H²÷N	218.5 P
E	68	J²	169
D-E	–13 J	F	267
H	35	J²÷N	1.7
HJ	455	F-J²÷N	265.3 Q
HJ÷N	4.6		
2HJ÷N	9.2 K		

Numerator		Denominator	
C	231	PQ	57968
F	267	√PQ	240.8
C+F	498	2√PQ	481.6 S
G	292		
C+F-G	206 L		
K	9.2		
L-K	196.8 M	M÷S (Coef. of cor.)	.41 r_{xy}

To find P.E.$_r$

r²	.1681	
1-r²	.8319	T
√N	9.9	W
T÷W	.08	Z
.67Z	.05	P.E.$_r$

To find σ_x: P÷N (a), √a (b), C.I.$_x$ (c), b×c — σ_x

To find σ_y: Q÷N (d), √d (e), C.I.$_y$ (f), e×f — σ_y

To find M_x: d HCI$_x$, e g÷N, f M.V.$_x$, i+h — M_x

To find M_y: g JC.I.$_y$, h k÷N, i M.V.$_y$, n+m — M_y

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Table of Products

1	18 324	17 289	16 256	15 225	14 196	13 169	12 144	11 121	10 100	9 81	8 64	7 49	6 36	5 25	4 16	3 9	2 4	1 1	**1**	1 1	2 4	3 9	4 16	5 25	6 36	7 49	8 64
2	36 648	34 578	32 512	30 450	28 392	26 338	24 288	22 242	20 200	18 162	16 128	14 98	12 72	10 50	8 32	6 18	4 8	2 2	**2**	2 2	4 8	6 18	8 32	10 50	12 72	14 98	16 128
3	54 972	51 867	48 768	45 675	42 588	39 507	36 432	33 363	30 300	27 243	24 192	21 147	18 108	15 75	12 48	9 27	6 12	3 3	**3**	3 3	6 12	9 27	12 48	15 75	18 108	21 147	24 192
4	72 1296	68 1156	64 1024	60 900	56 784	52 676	48 576	44 484	40 400	36 324	32 256	28 196	24 144	20 100	16 64	12 36	8 16	4 4	**4**	4 4	8 16	12 36	16 64	20 100	24 144	28 196	32 256
5	90 1620	85 1445	80 1280	75 1125	70 980	65 845	60 720	55 605	50 500	45 405	40 320	35 245	30 180	25 125	20 80	15 45	10 20	5 5	**5**	5 5	10 20	15 45	20 80	25 125	30 180	35 245	40 320
6	108 1944	102 1734	96 1536	90 1350	84 1176	78 1014	72 864	66 726	60 600	54 486	48 384	42 294	36 216	30 150	24 96	18 54	12 24	6 6	**6**	6 6	12 24	18 54	24 96	30 150	36 216	42 294	48 384
7			112 1792	105 1575	98 1372	91 1183	84 1008	77 847	70 700	63 567	56 448	49 343	42 252	35 175	28 112	21 63	14 28	7 7	**7**	7 7	14 28	21 63	28 112	35 175	42 252	49 343	56 448
8				120 1800	112 1568	104 1352	96 1152	88 968	80 800	72 648	64 512	56 392	48 288	40 200	32 128	24 72	16 32	8 8	**8**	8 8	16 32	24 72	32 128	40 200	48 288	56 392	64 512
9					126 1764	117 1521	108 1296	99 1089	90 900	81 729	72 576	63 441	54 324	45 225	36 144	27 81	18 36	9 9	**9**	9 9	18 36	27 81	36 144	45 225	54 324	63 441	72 576
10					140 1960	130 1690	120 1440	110 1210	100 1000	90 810	80 640	70 490	60 360	50 250	40 160	30 90	20 40	10 10	**10**	10 10	20 40	30 90	40 160	50 250	60 360	70 490	80 640
11						143 1859	132 1584	121 1331	110 1100	99 891	88 704	77 539	66 396	55 275	44 176	33 99	22 44	11 11	**11**	11 11	22 44	33 99	44 176	55 275	66 396	77 539	88 704
12							144 1728	132 1452	120 1200	108 972	96 768	84 588	72 432	60 300	48 192	36 108	24 48	12 12	**12**	12 12	24 48	36 108	48 192	60 300	72 432	84 588	96 768
13							156 1872	143 1573	130 1300	117 1053	104 832	91 637	78 468	65 325	52 208	39 117	26 52	13 13	**13**	13 13	26 52	39 117	52 208	65 325	78 468	91 637	104 832
14								154 1694	140 1400	126 1134	112 896	98 686	84 504	70 350	56 224	42 126	28 56	14 14	**14**	14 14	28 56	42 126	56 224	70 350	84 504	98 686	112 896
15								165 1815	150 1500	135 1215	120 960	105 735	90 540	75 375	60 240	45 135	30 60	15 15	**15**	15 15	30 60	45 135	60 240	75 375	90 540	105 735	120 960
16								176 1936	160 1600	144 1296	128 1024	112 784	96 576	80 400	64 256	48 144	32 64	16 16	**16**	16 16	32 64	48 144	64 256	80 400	96 576	112 784	128 1024
17									170 1700	153 1377	136 1088	119 833	102 612	85 425	68 272	51 153	34 68	17 17	**17**	17 17	34 68	51 153	68 272	85 425	102 612	119 833	136 1088
18									180 1800	162 1458	144 1152	126 882	108 648	90 450	72 288	54 162	36 72	18 18	**18**	18 18	36 72	54 162	72 288	90 450	108 648	126 882	144 1152
19									190 1900	171 1539	152 1216	133 931	114 684	95 475	76 304	57 171	38 76	19 19	**19**	19 19	38 76	57 171	76 304	95 475	114 684	133 931	152 1216
20										180 1620	160 1280	140 980	120 720	100 500	80 320	60 180	40 80	20 20	**20**	20 20	40 80	60 180	80 320	100 500	120 720	140 980	160 1280
21										189 1701	168 1344	147 1029	126 756	105 525	84 336	63 189	42 84	21 21	**21**	21 21	42 84	63 189	84 336	105 525	126 756	147 1029	168 1344
22										198 1782	176 1408	154 1078	132 792	110 550	88 352	66 198	44 88	22 22	**22**	22 22	44 88	66 198	88 352	110 550	132 792	154 1078	176 1408
23										207 1863	184 1472	161 1127	138 828	115 575	92 368	69 207	46 92	23 23	**23**	23 23	46 92	69 207	92 368	115 575	138 828	161 1127	184 1472
24										216 1944	192 1536	168 1176	144 864	120 600	96 384	72 216	48 96	24 24	**24**	24 24	48 96	72 216	96 384	120 600	144 864	168 1176	192 1536
25											200 1600	175 1225	150 900	125 625	100 400	75 225	50 100	25 25	**25**	25 25	50 100	75 225	100 400	125 625	150 900	175 1225	200 1600
26											208 1664	182 1274	156 936	130 650	104 416	78 234	52 104	26 26	**26**	26 26	52 104	78 234	104 416	130 650	156 936	182 1274	208 1664
27											216 1728	189 1323	162 972	135 675	108 432	81 243	54 108	27 27	**27**	27 27	54 108	81 243	108 432	135 675	162 972	189 1323	216 1728
28											224 1792	196 1372	168 1008	140 700	112 448	84 252	56 112	28 28	**28**	28 28	56 112	84 252	112 448	140 700	168 1008	196 1372	224 1792
29											232 1856	203 1421	174 1044	145 725	116 464	87 261	58 116	29 29	**29**	29 29	58 116	87 261	116 464	145 725	174 1044	203 1421	232 1856
30											240 1920	210 1470	180 1080	150 750	120 480	90 270	60 120	30 30	**30**	30 30	60 120	90 270	120 480	150 750	180 1080	210 1470	240 1920
31											248 1984	217 1519	186 1116	155 775	124 496	93 279	62 124	31 31	**31**	31 31	62 124	93 279	124 496	155 775	186 1116	217 1519	248 1984
32												224 1568	192 1152	160 800	128 512	96 288	64 128	32 32	**32**	32 32	64 128	96 288	128 512	160 800	192 1152	224 1568	256 2048
33												231 1617	198 1188	165 825	132 528	99 297	66 132	33 33	**33**	33 33	66 132	99 297	132 528	165 825	198 1188	231 1617	264 2112
34												238 1666	204 1224	170 850	136 544	102 306	68 136	34 34	**34**	34 34	68 136	102 306	136 544	170 850	204 1224	238 1666	272 2176
35												245 1715	210 1260	175 875	140 560	105 315	70 140	35 35	**35**	35 35	70 140	105 315	140 560	175 875	210 1260	245 1715	280 2240
36												252 1764	216 1296	180 900	144 576	108 324	72 144	36 36	**36**	36 36	72 144	108 324	144 576	180 900	216 1296	252 1764	288 2304
37												259 1813	222 1332	185 925	148 592	111 333	74 148	37 37	**37**	37 37	74 148	111 333	148 592	185 925	222 1332	259 1813	296 2368
38												266 1862	228 1368	190 950	152 608	114 342	76 152	38 38	**38**	38 38	76 152	114 342	152 608	190 950	228 1368	266 1862	304 2432
39												273 1911	234 1404	195 975	156 624	117 351	78 156	39 39	**39**	39 39	78 156	117 351	156 624	195 975	234 1404	273 1911	312 2496
40												280 1960	240 1440	200 1000	160 640	120 360	80 160	40 40	**40**	40 40	80 160	120 360	160 640	200 1000	240 1440	280 1960	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	79[illegible]
20	400	90	81[illegible]
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	190[illegible]
69	4761	139	19[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

Correlation between Achievement Test Scores (x) and Intelligence Quotients (y) r_{xy} = .46 ± .06

N 75 B 81 C 445

Class interval Y-variable: 70–79, 80–89, 90–99, 100–109, 110–119, 120–129, 130–139, 140–149, 150–159

Class interval X-variable: 0–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69 (center), 70–79, 80–89, 90–99

FV	V^2	V^2FV
	324	
	289	
	256	
	225	
	196	
	169	
	144	
	121	
	100	
	81	
	64	
	49	
1	36	36
1	25	25
8	16	128
10	9	90
19	4	76
16	1	16
20	0	0

N 75 G 371

N 75 E 50 F 212 A 70

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ \div N}{2\sqrt{(C-H^2 \div N)(F-J^2 \div N)}}$$

Calculation			
A	70	H^2	121
B	81	C	445
A−B	11 (H)	$H^2 \div N$	1.6
D	44	$C-H^2 \div N$	443.4 (P)
E	50	J^2	36
D−E	6 (J)	F	212
H	11	$J^2 \div N$	.5
HJ	66	$F-J^2 \div N$	211.5 (Q)
HJ÷N	.88	PQ	93779
2HJ÷N	1.76 (K)	$\sqrt{PQ}$	306.2
C	445	$2\sqrt{PQ}$	612.4 (S)
F	212		
C+F	657		
G	371		
C+F−G	286 (L)		
K	1.76		
L−K	284.24 (M) Numerator	M÷S	.46 r_{xy} Coef. of Cor.

To find P.E.$_r$: r^2 .2116; $1-r^2$ .7884 (T); $\sqrt{N}$ 8.66 (W); T÷W .09 (Z); .67Z .06 P.E.$_r$

To find σ_x: P÷N a; $\sqrt{a}$ b; C.I.$_x$ c; b×c σ_x

To find σ_y: Q÷N d; $\sqrt{d}$ e; C.I.$_y$ f; e×f σ_y

To find M_x: d HCI.$_x$; e g÷N; f M.V.$_x$; i+h M_x

To find M_y: g JCI.$_y$; h k÷N; i M.V.$_y$; n+m M_y

Published by World Book Company, Yonkers-on-Hudson, New York, and 2126 Prairie Avenue, Chicago.

Table of Products

40	39	38	37	36	35	34	33	32	31
									248 1984
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31
40	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519
320 2560	312 2496	304 2432	296 2368	288 2304	280 2240	272 2176	264 2112	256 2048	248 1984

30	29	28	27	26	25	24	23	22	21
						216 1944	207 1863	198 1782	189 1701
240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344
210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029
180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756
150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525
120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336
90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189
60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84
30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21
30	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**
30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21
60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84
90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189
120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336
150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525
180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756
210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029
240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344

20	19	18	17	16	15	14	13	12	11
									143 1859
							156 1872	144 1728	132 1584
				176 1936	165 1815	154 1694	143 1573	132 1452	121 1331
	190 1900	180 1800	170 1700	160 1600	150 1500	140 1400	130 1300	120 1200	110 1100
180 1620	171 1539	162 1458	153 1377	144 1296	135 1215	126 1134	117 1053	108 972	99 891
160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704
140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539
120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396
100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275
80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176
60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99
40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44
20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11
20	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**
20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11
40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44
60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99
80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176
100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275
120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396
140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539
160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704

10	9	8	7	6	5	4	3	2	1
				108 1944	90 1620	72 1296	54 972	36 648	18 324
				102 1734	85 1445	68 1156	51 867	34 578	17 289
			112 1792	96 1536	80 1280	64 1024	48 768	32 512	16 256
		120 1800	105 1575	90 1350	75 1125	60 900	45 675	30 450	15 225
140 1960	126 1764	112 1568	98 1372	84 1176	70 980	56 784	42 588	28 392	14 196
130 1690	117 1521	104 1352	91 1183	78 1014	65 845	52 676	39 507	26 338	13 169
120 1440	108 1296	96 1152	84 1008	72 864	60 720	48 576	36 432	24 288	12 144
110 1210	99 1089	88 968	77 847	66 726	55 605	44 484	33 363	22 242	11 121
100 1000	90 900	80 800	70 700	60 600	50 500	40 400	30 300	20 200	10 100
90 810	81 729	72 648	63 567	54 486	45 405	36 324	27 243	18 162	9 81
80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64
70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
10	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	[illegible]
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	[illegible]
69	4761	139	[illegible]
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

54

Correlation between Teachers' Geometry Marks (x) and Ninth Grade Algebra Marks (y) r_{xy} = .43 ± .05

N	105
B	72
C	482
A	102
N	105
G	786

FY	Y	YFY	Y^2	Y^2FY
	10		100	
	9		81	
	8		64	
6	7	42	49	294
0	6	0	36	0
3	5	15	25	75
3	4	12	16	48
13	3	39	9	117
10	2	20	4	40
8	1	8	1	8
12	0	D 136		0
11	1	11	1	11
16	2	32	4	64
23	3	69	9	207
	4		16	
	5		25	
	6		36	
	7		49	
	8		64	

N 105   E 112   F 864

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION

A	102	
B	72	
A-B	30	H
D	136	
E	112	
D-E	24	J
H	30	
HJ	720	
HJ÷N	7	
2HJ÷N	14	K
C	482	
F	864	
C+F	1346	
G	786	
C+F-G	560	L
K	14	
L-K	546	M (NUMERATOR)

H^2	900	
C	482	
$H^2\div N$	8.6	
$C-H^2\div N$	473.4	P
J^2	576	
F	864	
$J^2\div N$	5.5	
$F-J^2\div N$	858.5	Q
PQ	406414	
$\sqrt{PQ}$	637.5	
$2\sqrt{PQ}$	1275	S (DENOMINATOR)
M÷S	.43	r_{xy} (COEF. OF COR.)

To find P.E.r

r^2	.1849	
$1-r^2$	.8151	T
$\sqrt{N}$	10.25	W
T÷W	.08	Z
.6745 Z	.05	P.E.r

To find σ_x: P÷N a; $\sqrt{a}$ b; C.I.$_x$ c; b×c σ_x

To find σ_y: Q÷N d; $\sqrt{d}$ e; C.I.$_y$ f; e×f σ_y

To find M_x: d HCI.$_x$; e g÷N; f MV.$_x$; i+h M_x

To find M_y: g JC.I.$_y$; h k÷N; i M.V.$_y$; n+m M_y

Table of Products

1	18 / 324	17 / 289	16 / 256	15 / 225	14 / 196	13 / 169	12 / 144	11 / 121	10 / 100	9 / 81	8 / 64	7 / 49	6 / 36	5 / 25	4 / 16	3 / 9	2 / 4	1 / 1	1	1 / 1	2 / 4	3 / 9	4 / 16	5 / 25	6 / 36	7 / 49	8 / 64
2	36 / 648	34 / 578	32 / 512	30 / 450	28 / 392	26 / 338	24 / 288	22 / 242	20 / 200	18 / 162	16 / 128	14 / 98	12 / 72	10 / 50	8 / 32	6 / 18	4 / 8	2 / 2	2	2 / 2	4 / 8	6 / 18	8 / 32	10 / 50	12 / 72	14 / 98	16 / 128
3	54 / 972	51 / 867	48 / 768	45 / 675	42 / 588	39 / 507	36 / 432	33 / 363	30 / 300	27 / 243	24 / 192	21 / 147	18 / 108	15 / 75	12 / 48	9 / 27	6 / 12	3 / 3	3	3 / 3	6 / 12	9 / 27	12 / 48	15 / 75	18 / 108	21 / 147	24 / 192
4	72 / 1296	68 / 1156	64 / 1024	60 / 900	56 / 784	52 / 676	48 / 576	44 / 484	40 / 400	36 / 324	32 / 256	28 / 196	24 / 144	20 / 100	16 / 64	12 / 36	8 / 16	4 / 4	4	4 / 4	8 / 16	12 / 36	16 / 64	20 / 100	24 / 144	28 / 196	32 / 256
5	90 / 1620	85 / 1445	80 / 1280	75 / 1125	70 / 980	65 / 845	60 / 720	55 / 605	50 / 500	45 / 405	40 / 320	35 / 245	30 / 180	25 / 125	20 / 80	15 / 45	10 / 20	5 / 5	5	5 / 5	10 / 20	15 / 45	20 / 80	25 / 125	30 / 180	35 / 245	40 / 320
6	108 / 1944	102 / 1734	96 / 1536	90 / 1350	84 / 1176	78 / 1014	72 / 864	66 / 726	60 / 600	54 / 486	48 / 384	42 / 294	36 / 216	30 / 150	24 / 96	18 / 54	12 / 24	6 / 6	6	6 / 6	12 / 24	18 / 54	24 / 96	30 / 150	36 / 216	42 / 294	48 / 384
7			112 / 1792	105 / 1575	98 / 1372	91 / 1183	84 / 1008	77 / 847	70 / 700	63 / 567	56 / 448	49 / 343	42 / 252	35 / 175	28 / 112	21 / 63	14 / 28	7 / 7	7	7 / 7	14 / 28	21 / 63	28 / 112	35 / 175	42 / 252	49 / 343	56 / 448
8				120 / 1800	112 / 1568	104 / 1352	96 / 1152	88 / 968	80 / 800	72 / 648	64 / 512	56 / 392	48 / 288	40 / 200	32 / 128	24 / 72	16 / 32	8 / 8	8	8 / 8	16 / 32	24 / 72	32 / 128	40 / 200	48 / 288	56 / 392	64 / 512
9					126 / 1764	117 / 1521	108 / 1296	99 / 1089	90 / 900	81 / 729	72 / 576	63 / 441	54 / 324	45 / 225	36 / 144	27 / 81	18 / 36	9 / 9	9	9 / 9	18 / 36	27 / 81	36 / 144	45 / 225	54 / 324	63 / 441	72 / 576
10					140 / 1960	130 / 1690	120 / 1440	110 / 1210	100 / 1000	90 / 810	80 / 640	70 / 490	60 / 360	50 / 250	40 / 160	30 / 90	20 / 40	10 / 10	10	10 / 10	20 / 40	30 / 90	40 / 160	50 / 250	60 / 360	70 / 490	80 / 640
11						143 / 1859	132 / 1584	121 / 1331	110 / 1100	99 / 891	88 / 704	77 / 539	66 / 396	55 / 275	44 / 176	33 / 99	22 / 44	11 / 11	11	11 / 11	22 / 44	33 / 99	44 / 176	55 / 275	66 / 396	77 / 539	88 / 704
12							144 / 1728	132 / 1452	120 / 1200	108 / 972	96 / 768	84 / 588	72 / 432	60 / 300	48 / 192	36 / 108	24 / 48	12 / 12	12	12 / 12	24 / 48	36 / 108	48 / 192	60 / 300	72 / 432	84 / 588	96 / 768
13							156 / 1872	143 / 1573	130 / 1300	117 / 1053	104 / 832	91 / 637	78 / 468	65 / 325	52 / 208	39 / 117	26 / 52	13 / 13	13	13 / 13	26 / 52	39 / 117	52 / 208	65 / 325	78 / 468	91 / 637	104 / 832
14								154 / 1694	140 / 1400	126 / 1134	112 / 896	98 / 686	84 / 504	70 / 350	56 / 224	42 / 126	28 / 56	14 / 14	14	14 / 14	28 / 56	42 / 126	56 / 224	70 / 350	84 / 504	98 / 686	112 / 896
15								165 / 1815	150 / 1500	135 / 1215	120 / 960	105 / 735	90 / 540	75 / 375	60 / 240	45 / 135	30 / 60	15 / 15	15	15 / 15	30 / 60	45 / 135	60 / 240	75 / 375	90 / 540	105 / 735	120 / 960
16								176 / 1936	160 / 1600	144 / 1296	128 / 1024	112 / 784	96 / 576	80 / 400	64 / 256	48 / 144	32 / 64	16 / 16	16	16 / 16	32 / 64	48 / 144	64 / 256	80 / 400	96 / 576	112 / 784	128 / 1024
17									170 / 1700	153 / 1377	136 / 1088	119 / 833	102 / 612	85 / 425	68 / 272	51 / 153	34 / 68	17 / 17	17	17 / 17	34 / 68	51 / 153	68 / 272	85 / 425	102 / 612	119 / 833	136 / 1088
18									180 / 1800	162 / 1458	144 / 1152	126 / 882	108 / 648	90 / 450	72 / 288	54 / 162	36 / 72	18 / 18	18	18 / 18	36 / 72	54 / 162	72 / 288	90 / 450	108 / 648	126 / 882	144 / 1152
19									190 / 1900	171 / 1539	152 / 1216	133 / 931	114 / 684	95 / 475	76 / 304	57 / 171	38 / 76	19 / 19	19	19 / 19	38 / 76	57 / 171	76 / 304	95 / 475	114 / 684	133 / 931	152 / 1216
20										180 / 1620	160 / 1280	140 / 980	120 / 720	100 / 500	80 / 320	60 / 180	40 / 80	20 / 20	20	20 / 20	40 / 80	60 / 180	80 / 320	100 / 500	120 / 720	140 / 980	160 / 1280
21										189 / 1701	168 / 1344	147 / 1029	126 / 756	105 / 525	84 / 336	63 / 189	42 / 84	21 / 21	21	21 / 21	42 / 84	63 / 189	84 / 336	105 / 525	126 / 756	147 / 1029	168 / 1344
22										198 / 1782	176 / 1408	154 / 1078	132 / 792	110 / 550	88 / 352	66 / 198	44 / 88	22 / 22	22	22 / 22	44 / 88	66 / 198	88 / 352	110 / 550	132 / 792	154 / 1078	176 / 1408
23										207 / 1863	184 / 1472	161 / 1127	138 / 828	115 / 575	92 / 368	69 / 207	46 / 92	23 / 23	23	23 / 23	46 / 92	69 / 207	92 / 368	115 / 575	138 / 828	161 / 1127	184 / 1472
24										216 / 1944	192 / 1536	168 / 1176	144 / 864	120 / 600	96 / 384	72 / 216	48 / 96	24 / 24	24	24 / 24	48 / 96	72 / 216	96 / 384	120 / 600	144 / 864	168 / 1176	192 / 1536
25											200 / 1600	175 / 1225	150 / 900	125 / 625	100 / 400	75 / 225	50 / 100	25 / 25	25	25 / 25	50 / 100	75 / 225	100 / 400	125 / 625	150 / 900	175 / 1225	200 / 1600
26											208 / 1664	182 / 1274	156 / 936	130 / 650	104 / 416	78 / 234	52 / 104	26 / 26	26	26 / 26	52 / 104	78 / 234	104 / 416	130 / 650	156 / 936	182 / 1274	208 / 1664
27											216 / 1728	189 / 1323	162 / 972	135 / 675	108 / 432	81 / 243	54 / 108	27 / 27	27	27 / 27	54 / 108	81 / 243	108 / 432	135 / 675	162 / 972	189 / 1323	216 / 1728
28											224 / 1792	196 / 1372	168 / 1008	140 / 700	112 / 448	84 / 252	56 / 112	28 / 28	28	28 / 28	56 / 112	84 / 252	112 / 448	140 / 700	168 / 1008	196 / 1372	224 / 1792
29											232 / 1856	203 / 1421	174 / 1044	145 / 725	116 / 464	87 / 261	58 / 116	29 / 29	29	29 / 29	58 / 116	87 / 261	116 / 464	145 / 725	174 / 1044	203 / 1421	232 / 1856
30											240 / 1920	210 / 1470	180 / 1080	150 / 750	120 / 480	90 / 270	60 / 120	30 / 30	30	30 / 30	60 / 120	90 / 270	120 / 480	150 / 750	180 / 1080	210 / 1470	240 / 1920
31											248 / 1984	217 / 1519	186 / 1116	155 / 775	124 / 496	93 / 279	62 / 124	31 / 31	31	31 / 31	62 / 124	93 / 279	124 / 496	155 / 775	186 / 1116	217 / 1519	248 / 1984
32												224 / 1568	192 / 1152	160 / 800	128 / 512	96 / 288	64 / 128	32 / 32	32	32 / 32	64 / 128	96 / 288	128 / 512	160 / 800	192 / 1152	224 / 1568	256 / 2048
33												231 / 1617	198 / 1188	165 / 825	132 / 528	99 / 297	66 / 132	33 / 33	33	33 / 33	66 / 132	99 / 297	132 / 528	165 / 825	198 / 1188	231 / 1617	264 / 2112
34												238 / 1666	204 / 1224	170 / 850	136 / 544	102 / 306	68 / 136	34 / 34	34	34 / 34	68 / 136	102 / 306	136 / 544	170 / 850	204 / 1224	238 / 1666	272 / 2176
35												245 / 1715	210 / 1260	175 / 875	140 / 560	105 / 315	70 / 140	35 / 35	35	35 / 35	70 / 140	105 / 315	140 / 560	175 / 875	210 / 1260	245 / 1715	280 / 2240
36												252 / 1764	216 / 1296	180 / 900	144 / 576	108 / 324	72 / 144	36 / 36	36	36 / 36	72 / 144	108 / 324	144 / 576	180 / 900	216 / 1296	252 / 1764	288 / 2304
37												259 / 1813	222 / 1332	185 / 925	148 / 592	111 / 333	74 / 148	37 / 37	37	37 / 37	74 / 148	111 / 333	148 / 592	185 / 925	222 / 1332	259 / 1813	296 / 2368
38												266 / 1862	228 / 1368	190 / 950	152 / 608	114 / 342	76 / 152	38 / 38	38	38 / 38	76 / 152	114 / 342	152 / 608	190 / 950	228 / 1368	266 / 1862	304 / 2432
39												273 / 1911	234 / 1404	195 / 975	156 / 624	117 / 351	78 / 156	39 / 39	39	39 / 39	78 / 156	117 / 351	156 / 624	195 / 975	234 / 1404	273 / 1911	312 / 2496
40												280 / 1960	240 / 1440	200 / 1000	160 / 640	120 / 360	80 / 160	40 / 40	40	40 / 40	80 / 160	120 / 360	160 / 640	200 / 1000	240 / 1440	280 / 1960	320 / 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7921
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19044
69	4761	139	19321
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

Correlation between *Achievement Test Score* (x) and *Ninth Grade Algebra Marks* (y) r_{xy} = *.51* ± *.05*

CLASS INTERVAL Y-VARIABLE: 60-62, 63-65, 66-68, 69-71, 72-74, 75-77, 78-80, 81-83, 84-86, 87-89, 90-92

V²	324	289	256	225	196	169	144	121	100	81	64	49	36	25	16	9	4	1	0
FV													2	8	8	10	19	22	13
V²FV													72	200	128	90	76	22	0

N = 82, G = 588

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ \div N}{2\sqrt{(C-H^2 \div N)(F-J^2 \div N)}}$$

Y	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10
FY						18	11	8	9	6	9	11	3	2	0	5			
YFY						54	22	8	114 (D)	6	18	33	12	10	0	35			
Y²	64	49	36	25	16	9	4	1		1	4	9	16	25	36	49	64	81	100
Y²FY						162	44	8	0	6	36	99	48	50	0	245			

N 82   E 84   F 698

N 82   B 84   C 440   A 70

CALCULATION

A	70	
B	84	
A-B	14	H
D	114	
E	84	
D-E	30	J
H	14	
HJ	420	
HJ÷N	5	
2HJ÷N	10	K
C	440	
F	698	
C+F	1138	
G	588	
C+F-G	550	L
K	10	
L-K	560	M

NUMERATOR

H²	196	
C	440	
H²÷N	2.4	
C-H²÷N	437.6	P
J²	900	
F	698	
J²÷N	11	
F-J²÷N	687	Q
PQ	300631	
√PQ	548.3	
2√PQ	1096.6	S

DENOMINATOR

M÷S = .51 r_{xy} COEF. OF COR.

To find P.E.$_r$

r²	.2601	
1-r²	.7399	T
√N	9.06	W
T÷W	.08	Z
.67Z	.05	P.E.$_r$

To find σ_x: P÷N a, √a b, C.I.$_x$ c, b×c σ_x

To find σ_y: Q÷N d, √d e, C.I.$_y$ f, e×f σ_y

To find M_x: H.C.I.$_x$ g, g÷N h, M.V.$_x$ i, i+h M_x

To find M_y: J.C.I.$_y$ k, k÷N m, M.V.$_y$ n, n+m M_y

Published by World Book Company, Yonkers-on-Hudson, New York, and 2126 Prairie Avenue, Chicago.

Table of Products

1	2	3	4	5	6	7	8	9	10
18 324	36 648	54 972	72 1296	90 1620	108 1944				
17 289	34 578	51 867	68 1156	85 1445	102 1734				
16 256	32 512	48 768	64 1024	80 1280	96 1536	112 1792			
15 225	30 450	45 675	60 900	75 1125	90 1350	105 1575	120 1800		
14 196	28 392	42 588	56 784	70 980	84 1176	98 1372	112 1568	126 1764	140 1960
13 169	26 338	39 507	52 676	65 845	78 1014	91 1185	104 1352	117 1521	130 1690
12 144	24 288	36 432	48 576	60 720	72 864	84 1008	96 1152	108 1296	120 1440
11 121	22 242	33 363	44 484	55 605	66 726	77 847	88 968	99 1089	110 1210
10 100	20 200	30 300	40 400	50 500	60 600	70 700	80 800	90 900	100 1000
9 81	18 162	27 243	36 324	45 405	54 486	63 567	72 648	81 729	90 810
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490
6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360
5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250
4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160
3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90
2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40
1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10
2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40
3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90
4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160
5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250
6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640

11	12	13	14	15	16	17	18	19	20
143 1859									
132 1584	144 1728	156 1872							
121 1331	132 1452	143 1573	154 1694	165 1815	176 1936				
110 1100	120 1200	130 1300	140 1400	150 1500	160 1600	170 1700	180 1800	190 1900	
99 891	108 972	117 1053	126 1134	135 1215	144 1296	153 1377	162 1458	171 1539	180 1620
88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280
77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980
66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720
55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500
44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320
33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180
22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80
11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20
22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80
33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180
44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320
55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500
66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720
77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980
88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280

21	22	23	24	25	26	27	28	29	30
189 1701	198 1782	207 1863	216 1944						
168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920
147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470
126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080
105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750
84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480
63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270
42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120
21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30
42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120
63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270
84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480
105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750
126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080
147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470
168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920

31	32	33	34	35	36	37	38	39	40
248 1984									
217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
248 1984	256 2048	264 2112	272 2176	280 2240	288 2304	296 2368	304 2432	312 2496	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7[illegible]
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19[illegible]
69	4761	139	19321
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

Correlation between Tal't score (x) and Intelligence Quotients (y) r_{xy} = .50 ± .06

CLASS INTERVAL Y-VARIABLE: 77-83, 84-90, 91-97, 98-104, 105-111, 112-118 (center), 119-125, 126-132, 133-139, 140-146, 147-153

N 79 | B 58 | C 492 | A 94 | G 437 | N 79 | E 48 | F 425 | D 91

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION			
A	94	H^2	1296
B	58	C	492
A-B	36 H	$H^2\div N$	16.4
D	91	$C-H^2\div N$	475.6 P
E	48	J^2	1849
D-E	43 J	F	425
H	36	$J^2\div N$	23.4
HJ	1548	$F-J^2\div N$	401.6 Q
HJ÷N	19.6	PQ	191,001
2HJ÷N	39.2 K	$\sqrt{PQ}$	437
C	492	$2\sqrt{PQ}$	874 S (DENOMINATOR)
F	425	M÷S	.50 r_{xy} (COEF. OF COR.)
C+F	917		
G	437		
C+F-G	480 L		
K	39.2		
L-K	440.8 M (NUMERATOR)		

To find P.E.r

r^2	.25
$1-r^2$	.75 T
$\sqrt{N}$	8.89 W
T÷W	.084 Z
.67Z	.06 P.E.r

To find σ_x: P÷N a, $\sqrt{a}$ b, C.I.$_x$ c, b×c σ_x

To find σ_y: Q÷N d, $\sqrt{d}$ e, C.I.$_y$ f, e×f σ_y

To find M_x: d HCI.$_x$, e g÷N, f M.V.$_x$, i+h M_x

To find M_y: g JC.I.$_y$, h k÷N, i M.V.$_y$, n+m M_y

Table of Products

1	2	3	4	5	6	7	8	9	10
18 324	36 648	54 972	72 1296	90 1620	108 1944				
17 289	34 578	51 867	68 1156	85 1445	102 1734				
16 256	32 512	48 768	64 1024	80 1280	96 1536	112 1792			
15 225	30 450	45 675	60 900	75 1125	90 1350	105 1575	120 1800		
14 196	28 392	42 588	56 784	70 980	84 1176	98 1372	112 1568	126 1764	140 1960
13 169	26 338	39 507	52 676	65 845	78 1014	91 1183	104 1352	117 1521	130 1690
12 144	24 288	36 432	48 576	60 720	72 864	84 1008	96 1152	108 1296	120 1440
11 121	22 242	33 363	44 484	55 605	66 726	77 847	88 968	99 1089	110 1210
10 100	20 200	30 300	40 400	50 500	60 600	70 700	80 800	90 900	100 1000
9 81	18 162	27 243	36 324	45 405	54 486	63 567	72 648	81 729	90 810
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490
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2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40
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1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
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2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40
3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90
4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160
5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250
6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640

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143 1859									
132 1584	144 1728	156 1872							
121 1331	132 1452	143 1573	154 1694	165 1815	176 1936				
110 1100	120 1200	130 1300	140 1400	150 1500	160 1600	170 1700	180 1800	190 1900	
99 891	108 972	117 1053	126 1134	135 1215	144 1296	153 1377	162 1458	171 1539	180 1620
88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280
77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980
66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720
55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500
44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320
33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180
22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80
11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20
22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80
33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180
44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320
55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500
66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720
77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980
88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280

21	22	23	24	25	26	27	28	29	30
189 1701	198 1782	207 1863	216 1944						
168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920
147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470
126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080
105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750
84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480
63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270
42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120
21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30
42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120
63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270
84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480
105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750
126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080
147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470
168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920

31	32	33	34	35	36	37	38	39	40
248 1984									
217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
248 1984	256 2048	264 2112	272 2176	280 2240	288 2304	296 2368	304 2432	312 2496	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7921
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19044
69	4761	139	19321
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

Correlation between Sec. 1 Sch. Scores (x) and Ninth Grade Algebra Marks (y) r_{xy} = .31 ± .07

N 83 | B 60 | C 577 | A 109

X-variable class interval (From–To)	X	FX	XFX	X^2	X^2FX
	8			64	
	7			49	
	6			36	
	5			25	
0–5	4	4	16	16	64
6–11	3	3	9	9	27
12–17	2	12	24	4	48
18–23	1	11	11	1	11
24–29	0	15	109 (A)		0
30–35 (center)	1	10	10	1	10
36–41	2	11	22	4	44
42–47	3	5	15	9	45
48–53	4	3	12	16	48
54–59	5	4	20	25	100
60–65	6	5	30	36	180
	7			49	
	8			64	
	9			81	
	10			100	

Y-variable class interval (From–To)	FY	Y	YFY	Y^2	Y^2FY
		10		100	
		9		81	
		8		64	
90–92	5	7	35	49	245
87–89	0	6	0	36	0
84–86	2	5	10	25	50
81–83	3	4	12	16	48
78–80	6	3	18	9	54
75–77	9	2	18	4	36
72–74 (center)	7	1	7	1	7
69–71	9	0	100 (D)		0
66–68	12	1	12	1	12
63–65	13	2	26	4	52
60–62	17	3	51	9	153
		4		16	
		5		25	
		6		36	
		7		49	
		8		64	

V	FV	V^2	V^2FV
s		324	
r		289	
q		256	
p		225	
o		196	
n		169	
m		144	
l		121	
k		100	
j	2	64	128
i	2	49	98
h	1	36	36
g	9	25	225
f	13	16	208
e	9	9	81
d	12	4	48
c	26	1	26
b	9	0	0
	N 83		G 850

N 83 | E 89 | F 657 | D 100 | G 850

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ \div N}{2\sqrt{(C-H^2 \div N)(F-J^2 \div N)}}$$

Calculation			
A	109	H^2	2401
B	60	C	577
A−B	49 (H)	$H^2 \div N$	29
D	100	$C-H^2 \div N$	548 (P)
E	89	J^2	121
D−E	11 (J)	F	657
H	49	$J^2 \div N$	1.5
HJ	539	$F-J^2 \div N$	655.5 (Q)
HJ÷N	6.5	PQ	359214
2HJ÷N	13 (K)	$\sqrt{PQ}$	599.3
C	577	$2\sqrt{PQ}$	1198.6 (S)
F	657		
C+F	1234		
G	850		
C+F−G	384 (L)		
K	13		
L−K	371 (M)		

Numerator: M 371 — Denominator: S 1198.6

M÷S = .31 r_{xy} (Coef. of Cor.)

To find P.E.r

r^2	.0961
$1-r^2$	.9039 (T)
$\sqrt{N}$	9.11 (W)
T÷W	.099 (Z)
.67Z	.07 (P.E.r)

To find σ_x

a P÷N · b $\sqrt{a}$ · c C.I.$_x$ · b×c — σ_x

To find σ_y

Q÷N · d $\sqrt{d}$ · C.I.$_y$ · e×f — σ_y

To find M_x

d HC.I.$_x$ · e g÷N · f M.V.$_x$ · i+h — M_x

To find M_y

g JC.I.$_y$ · h k÷N · i M.V.$_y$ · n+m — M_y

Published by World Book Company, Yonkers-on-Hudson, New York, and 2126 Prairie Avenue, Chicago.

Table of Products

40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
																																		108 1944	90 1620	72 1296	54 972	36 648	18 324
																																		102 1734	85 1445	68 1156	51 867	34 578	17 289
																																	112 1792	96 1536	80 1280	64 1024	48 768	32 512	16 256
																																120 1800	105 1575	90 1350	75 1125	60 900	45 675	30 450	15 225
																														140 1960	126 1764	112 1568	98 1372	84 1176	70 980	56 784	42 588	28 392	14 196
																													143 1859	130 1690	117 1521	104 1352	91 1183	78 1014	65 845	52 676	39 507	26 338	13 169
																											156 1872	144 1728	132 1584	120 1440	108 1296	96 1152	84 1008	72 864	60 720	48 576	36 432	24 288	12 144
																								176 1936	165 1815	154 1694	143 1573	132 1452	121 1331	110 1210	99 1089	88 968	77 847	66 726	55 605	44 484	33 363	22 242	11 121
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280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
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120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
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40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
40	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
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80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
320 2560	312 2496	304 2432	296 2368	288 2304	280 2240	272 2176	264 2112	256 2048	248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64

Table of Squares

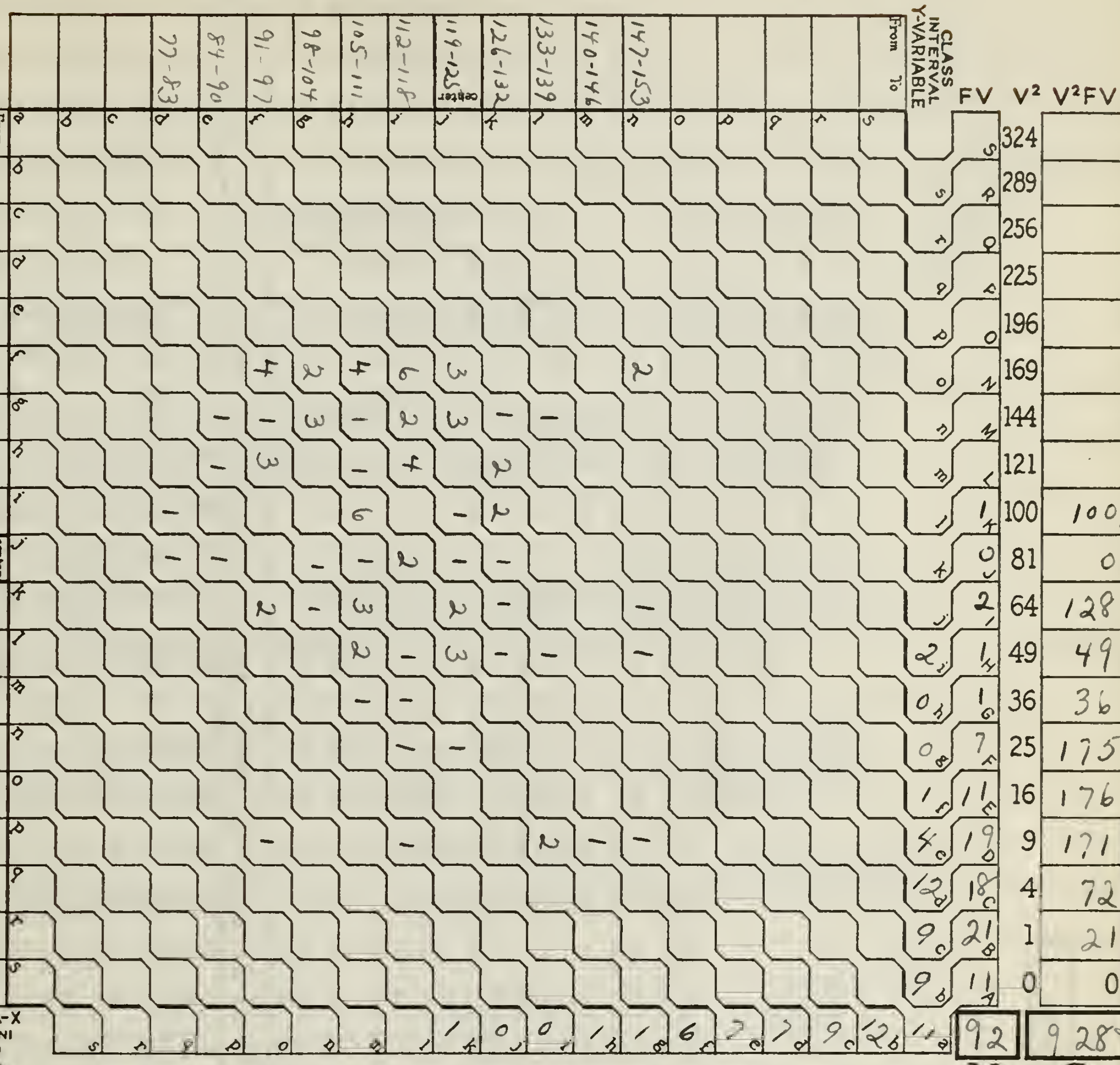
Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	[illegible]
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	[illegible]
69	4761	139	19321
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.

Author of the Otis Group Intelligence Scale

Correlation between Ninth Grade algebra marks (x) and Intelligence Quotients (y) r_{xy} = .25 ± .07



CLASS INTERVAL X-VARIABLE (From–To)	FX	X	XFX	X²	X²FX
		8		64	
		7		49	
		6		36	
		5		25	
		4		16	
60–62	12	3	63	9	189
63–65	13	2	26	4	52
66–68	11	1	11	1	11
69–71	10	0	A 115		0
72–74 (center)	3	1	8	1	8
75–77	10	2	20	4	40
78–80	6	3	27	9	81
81–83	2	4	8	16	32
84–86	2	5	10	25	50
87–89	0	6	0	36	0
90–92	6	7	42	49	294
		8		64	
		9		81	
		10		100	
	N 92		B 100		C 257

FY	Y	YFY	Y²	Y²FY
	10		100	
	9		81	
	8		64	
	7		49	
	6		36	
5	5	25	25	125
1	4	4	16	16
4	3	12	9	36
8	2	16	4	32
14	1	14	1	14
18	0	D 71		0
19	1	19	1	19
7	2	14	4	28
11	3	33	9	99
3	4	12	16	48
2	5	10	25	50
	6		36	
	7		49	
	8		64	
N 92		E 88		F 467

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ\div N}{2\sqrt{(C-H^2\div N)(F-J^2\div N)}}$$

CALCULATION

A	115
B	100
A-B	15 H
D	71
E	88
D-E	17 J
H	15
HJ	255
HJ÷N	2.8
2HJ÷N	5.6 K

H²	225
C	257
H²÷N	2.4
C-H²÷N	254.6 P
J²	289
F	467
J²÷N	3
F-J²÷N	464 Q

NUMERATOR

C	257
F	467
C+F	1224
G	928
C+F-G	296 L
K	5.6
L-K	301.6 M

DENOMINATOR

PQ	350134
√PQ	591.7
2√PQ	1183.4 S

COEF. OF COR.: M÷S = .25 r_{xy}

To find P.E.$_r$

r^2	.0625
$1-r^2$	.9375 T
$\sqrt{N}$	9.59 W
T÷W	.1 Z
.6745 Z	.07 P.E.$_r$

To find σ_x: a P÷N; b √a; c C.I.$_x$; b×c; σ_x

To find σ_y: d Q÷N; √d; C.I.$_y$; e×f; σ_y

To find M_x: d HCI.$_x$; e g÷N; f M.V.$_x$; i+h; M_x

To find M_y: g JC.I.$_y$; h k÷N; i M.V.$_y$; n+m; M_y

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Table of Products

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
18 324	36 648	54 972	72 1296	90 1620	108 1944																																		
17 289	34 578	51 867	68 1156	85 1445	102 1734																																		
16 256	32 512	48 768	64 1024	80 1280	96 1536	112 1792																																	
15 225	30 450	45 675	60 900	75 1125	90 1350	105 1575	120 1800																																
14 196	28 392	42 588	56 784	70 980	84 1176	98 1372	112 1568	126 1764	140 1960																														
13 169	26 338	39 507	52 676	65 845	78 1014	91 1183	104 1352	117 1521	130 1690	143 1859																													
12 144	24 288	36 432	48 576	60 720	72 864	84 1008	96 1152	108 1296	120 1440	132 1584	144 1728	156 1872																											
11 121	22 242	33 363	44 484	55 605	66 726	77 847	88 968	99 1089	110 1210	121 1331	132 1452	143 1573	154 1694	165 1815	176 1936																								
10 100	20 200	30 300	40 400	50 500	60 600	70 700	80 800	90 900	100 1000	110 1100	120 1200	130 1300	140 1400	150 1500	160 1600	170 1700	180 1800	190 1900																					
9 81	18 162	27 243	36 324	45 405	54 486	63 567	72 648	81 729	90 810	99 891	108 972	117 1053	126 1134	135 1215	144 1296	153 1377	162 1458	171 1539	180 1620	189 1701	198 1782	207 1863	216 1944																
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640	88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280	168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920	248 1984									
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490	77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980	147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470	217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360	66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720	126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080	186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250	55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500	105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750	155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160	44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320	84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480	124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90	33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180	63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270	93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40	22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80	42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120	62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20	21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30	31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12	13 13	14 14	15 15	16 16	17 17	18 18	19 19	20 20	21 21	22 22	23 23	24 24	25 25	26 26	27 27	28 28	29 29	30 30	31 31	32 32	33 33	34 34	35 35	36 36	37 37	38 38	39 39	40 40
2 4	4 8	6 12	8 16	10 20	12 24	14 28	16 32	18 36	20 40	22 44	24 48	26 52	28 56	30 60	32 64	34 68	36 72	38 76	40 80	42 84	44 88	46 92	48 96	50 100	52 104	54 108	56 112	58 116	60 120	62 124	64 128	66 132	68 136	70 140	72 144	74 148	76 152	78 156	80 160
3 9	6 18	9 27	12 36	15 45	18 54	21 63	24 72	27 81	30 90	33 99	36 108	39 117	42 126	45 135	48 144	51 153	54 162	57 171	60 180	63 189	66 198	69 207	72 216	75 225	78 234	81 243	84 252	87 261	90 270	93 279	96 288	99 297	102 306	105 315	108 324	111 333	114 342	117 351	120 360
4 16	8 32	12 48	16 64	20 80	24 96	28 112	32 128	36 144	40 160	44 176	48 192	52 208	56 224	60 240	64 256	68 272	72 288	76 304	80 320	84 336	88 352	92 368	96 384	100 400	104 416	108 432	112 448	116 464	120 480	124 496	128 512	132 528	136 544	140 560	144 576	148 592	152 608	156 624	160 640
5 25	10 50	15 75	20 100	25 125	30 150	35 175	40 200	45 225	50 250	55 275	60 300	65 325	70 350	75 375	80 400	85 425	90 450	95 475	100 500	105 525	110 550	115 575	120 600	125 625	130 650	135 675	140 700	145 725	150 750	155 775	160 800	165 825	170 850	175 875	180 900	185 925	190 950	195 975	200 1000
6 36	12 72	18 108	24 144	30 180	36 216	42 252	48 288	54 324	60 360	66 396	72 432	78 468	84 504	90 540	96 576	102 612	108 648	114 684	120 720	126 756	132 792	138 828	144 864	150 900	156 936	162 972	168 1008	174 1044	180 1080	186 1116	192 1152	198 1188	204 1224	210 1260	216 1296	222 1332	228 1368	234 1404	240 1440
7 49	14 98	21 147	28 196	35 245	42 294	49 343	56 392	63 441	70 490	77 539	84 588	91 637	98 686	105 735	112 784	119 833	126 882	133 931	140 980	147 1029	154 1078	161 1127	168 1176	175 1225	182 1274	189 1323	196 1372	203 1421	210 1470	217 1519	224 1568	231 1617	238 1666	245 1715	252 1764	259 1813	266 1862	273 1911	280 1960
8 64	16 128	24 192	32 256	40 320	48 384	56 448	64 512	72 576	80 640	88 704	96 768	104 832	112 896	120 960	128 1024	136 1088	144 1152	152 1216	160 1280	168 1344	176 1408	184 1472	192 1536	200 1600	208 1664	216 1728	224 1792	232 1856	240 1920	248 1984	256 2048	264 2112	272 2176	280 2240	288 2304	296 2368	304 2432	312 2496	320 2560

Table of Squares

Num.	Square	Num.	Square
11	121	81	6561
12	144	82	6724
13	169	83	6889
14	196	84	7056
15	225	85	7225
16	256	86	7396
17	289	87	7569
18	324	88	7744
19	361	89	7921
20	400	90	8100
21	441	91	8281
22	484	92	8464
23	529	93	8649
24	576	94	8836
25	625	95	9025
26	676	96	9216
27	729	97	9409
28	784	98	9604
29	841	99	9801
30	900	100	10000
31	961	101	10201
32	1024	102	10404
33	1089	103	10609
34	1156	104	10816
35	1225	105	11025
36	1296	106	11236
37	1369	107	11449
38	1444	108	11664
39	1521	109	11881
40	1600	110	12100
41	1681	111	12321
42	1764	112	12544
43	1849	113	12769
44	1936	114	12996
45	2025	115	13225
46	2116	116	13456
47	2209	117	13689
48	2304	118	13924
49	2401	119	14161
50	2500	120	14400
51	2601	121	14641
52	2704	122	14884
53	2809	123	15129
54	2916	124	15376
55	3025	125	15625
56	3136	126	15876
57	3249	127	16129
58	3364	128	16384
59	3481	129	16641
60	3600	130	16900
61	3721	131	17161
62	3844	132	17424
63	3969	133	17689
64	4096	134	17956
65	4225	135	18225
66	4356	136	18496
67	4489	137	18769
68	4624	138	19044
69	4761	139	19321
70	4900	140	19600
71	5041	141	19881
72	5184	142	20164
73	5329	143	20449
74	5476	144	20736
75	5625	145	21025
76	5776	146	21316
77	5929	147	21609
78	6084	148	21904
79	6241	149	22201
80	6400	150	22500

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889
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69
96

36
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